

Popular Science

September
1928
25 cents

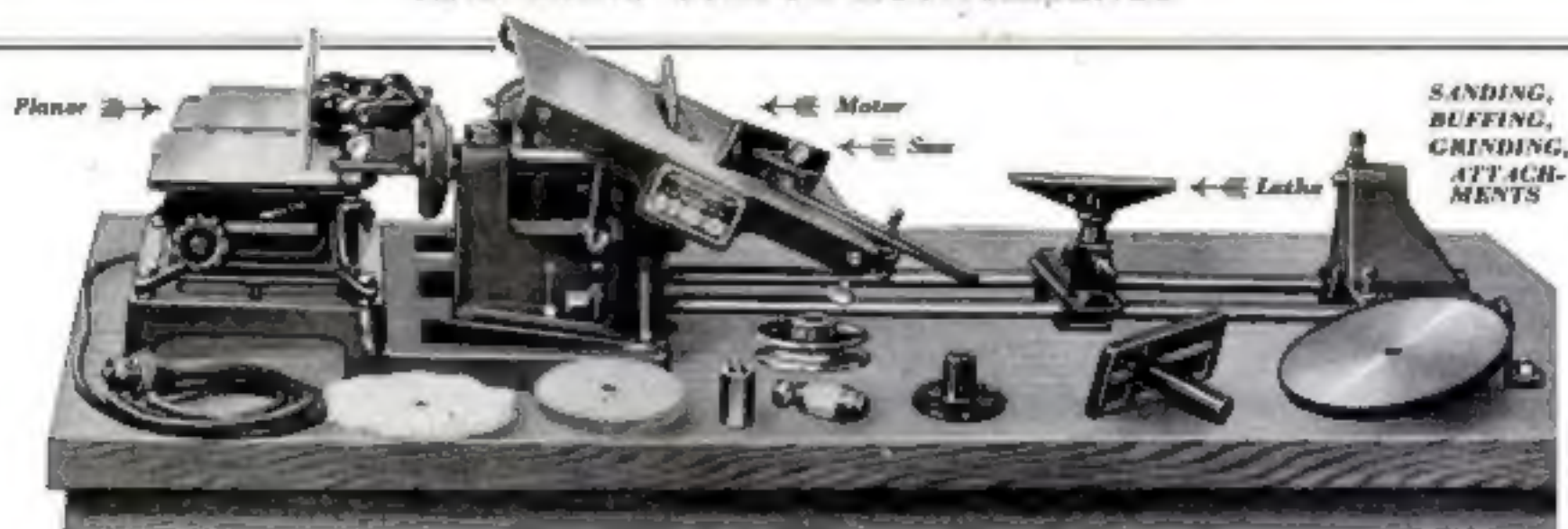
★ MONTHLY Founded 1872



New Ideas: Aviation - Radio and Television - Home Building
Engineering - Automobiles and The Home Workshop

WORKACE Electric WOODWORKER

COMPLETE OUTFIT INCLUDING PLANER, SAW, LATHE & ELECTRIC MOTOR
AND MANY USEFUL ATTACHMENTS



FAST—ACCURATE—COMPLETE

Every kind of woodworking operation

This is a COMPLETE All-Electric Shop. It costs a lot less than most other outfits—and for every dollar you pay, you're getting THE BIGGEST VALUE—you can't beat it, anywhere! You can prove every word of this by actually using the Workace Woodworker at home or in business . . . You'll find it fast

and accurate—you can perform every kind of wood-working operation, make furniture or other useful and decorative things for your own home or for profit. Planing, sawing, turning, drilling, grinding, sanding or buffing—it is all the same to the Workace Woodworker. You can save time on every operation, do the work better and cleaner, too!

Amazing low price

That's because all the modern up-to-date manufacturing facilities of the J. D. Wallace Company, suppliers of standard woodworking equipment for industrial and commercial uses, are utilized to produce the Workace Woodworker. Materials and workmanship are 100% and the designing of the Workace is strictly professional. Woodworking plants, pattern shops, carpenter and cabinet shops all over the world use Wallace equipment. It's the kind of machinery you want—you can't afford to own any other.

Become an expert woodworker

There is no end to the number of useful and decorative things you can make with the Workace. Tables, chairs, footstools, screens, lamps, lattices, fences, cabinets, doll houses, bookcases, chests—you'll soon become an expert. Woodworking is the greatest hobby a man can have—hundreds turn it to profit too.

The Workace Woodworker has power, strength and capacity to handle quickly and economically any job you'll ever want to do . . . mitring, tapering, rabbeting, beveling, slotting, turning, crosscutting, ripping—any-

\$89

Includes all this:

4" Planer
8" Circular Saw
6" x 36" Lathe
8" Disc Sander
6" Buffing Wheel
5" Emery Grinder
1/4" Drill Chuck
1/4" H. P. G. E.
Motor, 110
Volt, A. C.,
60 cycle
Endless V Belt,
two 4" and one
2 1/4" V Belt Pul-
leys, Cast Iron
Sub Base and 10
ft. Cable with
separable Plug.

includes everything

thing. Every unit works from the motor. The parts are sturdy and well-fashioned. The regular Wallace UNQUALIFIED GUARANTEE assures replacement of defective parts for one year.

EASY TERMS

Get the outfit right away

SEND TODAY

The terms are all in your favor. In fact, this whole advertisement, the merchandise offered and the easy method of purchasing is new and revolutionary.

A small down payment brings the complete Workace All-Electric Woodworker ready to set up and use right away. The monthly payments are so small you'll scarcely miss them. Many pay for their Workace Shop out of profits from the work it does. So can you.

Get it—use it—you'll find the Workace Electric Woodworker the best investment you ever made. Send this coupon now—today—and we'll see that you get full details and a complete description right away!

Wallace
PORTABLE MACHINES

The Planer and Circular Saw are each complete units and may be purchased separately at the correspondingly low price of \$25.00 each.

J. D. Wallace & Co.,
Wilcox and California Aves.,
Chicago, Illinois.

That Workace Electric Woodworker sure looks good to me. I want to know ALL about it, including your easy terms, right away.

Name.....

Address.....

City..... State.....

Used Cars, Good Will and Cadillac-La Salle Dealers

Millions in money cannot buy good-will. Yet good-will is the only investment which will return sure success to the used car business of Cadillac-La Salle dealers.

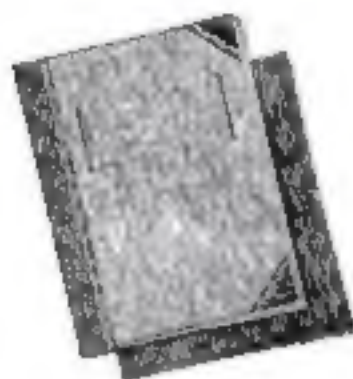
So Cadillac-La Salle dealers freely offer their integrity, their desire to satisfy, their business reputation to secure the good-will of their customers.

You need never hesitate to rely upon the Cadillac-La Salle dealer's word in the matter of used cars. You may be sure that he will not risk his future in his dealings with you.

CADILLAC MOTOR CAR COMPANY

Division of General Motors

Detroit Michigan



What is a Good Used Car?

How can a buyer make sure of 100 cents' worth of good used car for his dollar? What should a good used car provide?

This booklet, "What a Good Used Car Can Give You," presents twelve facts which answer these questions. A copy gladly sent on request — or your Cadillac-La Salle dealer will supply you.

CADILLAC MOTOR CAR COMPANY PSM-9-28
DETROIT, MICHIGAN

Since it does not obligate me, I should like . . . copies of your booklet of facts, "What A Good Used Car Can Give You."

Signal

Address

City State

WHAT IS NEW THIS MONTH

Table of Contents for September

LEADING ARTICLES

COVER DESIGN	By Herbert Paul	
A SHOE-STRING ADVENTURE IN THE STOCK MARKET	By Wallace Ames	4
The month's financial section		
HOW THE NEW RADIO SETS ARE TESTED	By Alexander Senauke	8
Results of the Popular Science Institute of Standards tests		
OUR READERS SAY—		10
MAKING OVER THE MOVIES	By Aiden P. Armagnac	13
Will "talking pictures" revolutionize a giant industry?		
LOST IN THE ARCTIC	By Edwin Ketchum	16
How air rescuers braved terrors of North to reach Noble		
HUGE BUILDING BURNED TO LEARN SECRETS OF FIRE	By H. C. Davis	18
What Bureau of Standards experts found in charred ruins		
NEW JOBS FOR OLD METALS	By E. E. Free	19
Amazing ways science is putting familiar elements to work		
A RAILROAD ON CUSHIONS	By John Walker Harrington	21
Engineering marvels of New York's newest train route		
JERRY SMASHES THROUGH	By Jesse F. Gelders	22
A gripping fiction story of the oil fields		
NEW MAGIC WORKED BY CAMERAS	By Ellsworth Bennett	25
How modern photography serves science and industry		
IS MAN PYGMY OR GIANT?	By William Bradley Otis	27
A college professor's answer to a remarkable question		
AIR TIME-TABLES NOW MAKE FLYING TRIPS EASY	By George Lee Dowd, Jr.	28
The inside facts about travel by air		
IS OIL BURNING TOO COSTLY?	By John E. Lodge	30
What to look for in a heating plant besides comfort		
TIPS FROM A VETERAN CARPENTER	By John R. McMahon	31
Practical facts an amateur housebuilder should know		
DO YOU KNOW HOW YOUR ICEBOX IS BUILT?	By R. D. Merrill	33
An engineer's version of what you get for your money		
MODEL RAILWAYS RIVAL REAL ONES	By L. O. Pope	34
Fascinating details of the most painstaking hobby of all		
DICK BYRD—ADVENTURER (Conclusion)	By Fitzhugh Green	37
A famous aerial explorer's next great project		
THE NEW RADIO SETS OFFER—	By John Carr	40
Fruits of a year's astounding technical advances		
THE REAL FACTS ABOUT TELEVISION	By Alfred P. Lane	43
What you can do today with sight by radio		
WELCOMING INVENTORS IN THE NAVY	By Norman C. McLoud	45
How a new award system spurs civilian genius		
FIRST WOMAN FLIES OVERSEA		47
Miss Earhart's aerial conquest of the Atlantic		
MAKING MODERNISTIC SCREENS		58
How to construct inexpensive up-to-date pieces		
HOW TO WHITTLE A SHIP MODEL	By E. Armitage McCann	60
Details of a clipper ship you can make with a jackknife		
OUTBOARD RACING SECRETS	By Newcomb Leonarde	61
Timely tips for the motorboating enthusiast		
WHAT GOOD IS AUTOMOBILE INSURANCE?	By Carl Helm	62
How far your policy covers you		
EDITORIALS		74
WHY "FIX" A BRAND-NEW CAR?	By Martin Bunn	76
Gus tells when to repair an auto—and when to leave it alone		

Automobiles

Rubber Bumper Softens Crashes	55
An Anti-Skid Fifth Wheel	55
Hand Button Starts Ford	55
Tool Straightens Fenders	55
Motorists' Mail Box	55
"Observation Body" Thwarts Back-Seat Drivers	55
Measures Oil's Viscosity	55
Motorcycle Carries 5 Police	64
Truck Driven from Outside	64
New Engine Slashes Gas Bills	65
Auto Lead in Use of Power	65
A 7-Horsepower English Car	66
Auto Launches Lifeboat	67
Auto Van Aids New Style Hunt	67
Puzzle in Auto Lights	70
Know Your Car	72
Large Terminals Built for Bus Lines	73
Does the Rain Drain Your Motor?	78
Fixing Broken Windows	78
A Radiator Screen	78
A Quick Way to Find Cotter-Pin Holes	78
How to Get Rid of Annoying Fumes	78

Aviation

Plane Races with Crack Train	30
What Do You Know about Aviation?	30
Italians Fly 4,400 Miles	45
Many Seek Endurance Record	48
Deadening a Plane's Roar	48
New Aero Motor Is Biggest	48
Nations Race to Lead in Air	48
Navy's Sikorsky Amphibian	49
Plane Ready for Catapult Launching	49
Junkers for New Nonstop Paris-Berlin Service	49
Safety Plane Flies in U. S.	49
Weather Man Flies for Data	49
Auto-Giro Crashes	49
Tries to Bent Air to Planes	49
Giant Zeppelin Will Go to Highest Bidder	66
Parachute Lands Entire Plane	67
Haven for Planes	71
Tests Show How Fast We Fall	137
Automobile Men Turning to Air	137
Combined Plane and Bus Lines	137

Exceptional People

Famous Physicist Is Part-Time Artist	54
Champion Slate Splitter	54
Owens and Drives Locomotive	54
Massachusetts' Firearms Expert	54
Twin Boy Students Make Diamonds	57
One Man Rules Tunnel Traffic	65

September, 1929, Vol. 112, No. 3, Popular Science Monthly is published monthly at 250 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. Entered as second-class matter Dec. 28, 1915, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Chicago, Illinois. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Copyright, 1929, by the Popular Science Publishing Co., Inc. Single copy, 25 cents. Yearly subscriptions to

United States, its possessions, and Canada, \$2.50; foreign countries, \$3. The contents of this magazine must not be reprinted without permission. In presenting in its editorial columns numerous stories of new products of applied science, Popular Science Monthly does not underwrite the business methods of the individuals or concerns producing them. The use of Popular Science Monthly articles for stock-selling schemes is never authorized. O. B. Capen, President and Treasurer; H. C. Wilson, Vice-President; A. L. Cole, Secretary.

Health and Hygiene

New Gains by Medicine	56
Measuring Your Sunburn Rate	56
Electric Machine Cures Cold in Few Minutes	57
Colds Are the Costliest	70
Cancer Cost Near a Billion	71

Laboratory Discoveries

New Use Found for Cadmium	64
Hunt Mysterious Element	70
Telescope May See Martians	131
Still Newer Uses of X Rays	134
Meteors Cause Imitation Quakes	142

Models and Toys

Model Tests Flood Control	68
Toys Teach Housebuilding	69
How to Build a Giant Model Airplane	80
Toy Hydroplane Travels at Great Speed	99

New Devices for the Home

A Water Power Mixer	50
Moth Balls in Hanger	50
Rolling Pin Contains 11 Utensils	50
Compact Dryer Saves Space	50
Vacuum Cleaner Sprays Paint	50
Takes Slack Out of Clothesline	50
Automatic Electric Waffle Cooker	50
Cuts Whole Cake at Once	50
Whisk Broom and Shoe Polisher in One	51
Tiny Necktie Ironing Board	51
A Dining Cabinet in Your Wall	51
Collapsible Bed Has Folding Spring	51
Presses Ties by Electricity	51
Makes Gas Cocks Foolproof	51
Suction Ash Tray Sticks to Wall	51
Disappearing Shoe-Shine Cabinet	51

New Processes and Inventions

Spoon in Bottle Cap	52
New Tool Clips Newspapers	52
Mechanical Billiard Instructor	52
Handle Shaving Brush Holder	52
A Finger Holds This Flashlight	52
Shovel Like Ice Cream Spoon	52
Novel Ash Tray Easy to Clean	52
New Razor Blade Sharpener	52
A Motor Boat That Folds	53
Odd Practice Violin	53
Reading Lamp Clamps on Book	53
"Sun Suit" Admits Health Rays	53
Spotlight in Shaving Mirror	53
New Pliers Grip Hexagon Nut	53
Coast Guard Sergeant Invents New Cable	54
Chemist Devises Bottle-Sealing Machine	54
Relief Maps Made by Machinery	57
Machine Beats Soporific Drugs in Producing Sleep	57

New Perfume in Paste Form	64
Airplane Wings on Sailboat	66
Wheel Mower for Railroads	68
Making Phone Speak Up	69

Photography

Photos in Natural Colors	70
Inventor Makes Wheels Spin Right Way in Movies	71
This Photographer Harnesses Sunlight	72

Radio

Solder That Needs No Iron	42
Long Loudspeaker Cords	42
Don't Be Fooled on Noises	42
When the Tuning Changes	42
Old Power Tubes Distort	42
A B C's of Radio	42
Marcconi Has New Project	50
Another Radio "Road?"	67
Press Button to Tune In	68
Huge Reflector Sends Beams of Radio	70
A Giant Radio Reflector	73

Ships

Largest U. S. Sub Also Safest	64
New Ship to Dwarf Leviathan	66
New Plane Carrier Sets Speed Record	71

Unusual Facts and Ideas

Two Victories over Pests	56
Most Mishaps Avoidable	56
Baffling Mysteries of Mining	64
Phone on Aerial Fire Engine	64
Clock Can Be Seen 20 Miles	64
20 Billion Ice Cream Cones	65
Gigantic English-Made Bell Coming to America	65
Cavalry Horses of Iron	65
Box Controls 2,000 Trains	66
Figures Deny "Rage Suicide"	66
Was Methuselah 969 Years Old?	66
Novel Use for Typewriter in Making Flexible Rules	67
Asbestos Suits Worn in Fire	67
Greater Power in Fire Boats	67
Dressing Ivory in Silver Coat	67
Tells How to Remember Names and Faces	68
Blows Icebergs to Bits	68
Mouse Traps Camouflaged as Corn-cobs and Cans	69
Kite Does 300 Loops	69
World's Biggest Bird Cage	69
Sounds That Climb Highest	69
Earthquake Telegraphs News of City's Doors	70
Much More Powerful Than TNT	70
Free Shower of Perfumes	71
Many Frogs; Prices Drop	71
No More Lost Golf Balls?	72
What Is Your Question?	72
Uncle Sam Runs a Stall	72

How to Wheel a Barrow	72
25,000,000 Go to School	72
How Much Do You Know of the World You Live In?	73
Room for Millions More	73
But Not Exactly a Relish	73
World's Largest Building	73
Fossil Is 600,000,000 Years Old	131
Great Oceans under the Ground	142

For the Home Owner

How to Drive Nails to Make Them Hold Fast	94
Keep Your House Looking New	104
Dress Up Your Old Furniture	106
You Can Build an Indoor Incinerator	118

Hints for the Mechanic

Sharpening Milling Cutters	84
Radial Attachment for Large Lathe Work	86
Tailstock Center for Grinding	86
Test Your Micrometer	88
Why Milling Cutters Run Out	88
Screw Slitters Make Slitting Disks	89
Stopping Throws Out Grinding Wheel	89
Double Time, Double Profit	89
Huddle for Swab Rag	17

Ideas for the Handy Man

Can and Candle Make Improved Lantern	82
Canoe Supports Waterproof Shelter	82
Makes Drinking Water Safe for Campers	82
Forked Sticks Make Camp Chair	82
Netting Support Fells Mosquitoes	82
An Inner-Tube Air Pillow	82
Fastening Tent-Stakes	82
Tin Cans Converted into Cooking Utensils	82
Substantial Board Chair Easy to Make	82
A Practical Fishing-Tackle Box	82
Making a Boomerang	82
Novel Air-Rifle Target	82
Tables for the Wood Turner	83
Back Yard Chute-the-Chutes	90
Making a Spanish-Colonial Wood Box	90
Old Stove Bowl Used as Temporary Forge	96
Unique Triple Stand Combined with an Electric Lamp	97
Home Fire Alarm Rings When Heat Melts Paraffin	99
Shield for Paint Spraying	101
Blueprints for Your Home Workshop	102
How to Test Distilled Water	103
When to Use Quarter-Sawn Boards	108
Sturdy Jig Saw Built at Low Cost	110
Neat Rack for Paint Brushes	113
Shavings Used to Imitate Difficult Inlaid Work	112
Glass Case Protects Narrow Saws	112
Quickly Made Kitchen Stool	120

NEXT MONTH—Fascinating articles that will tell of the latest achievements of invention and discovery; also practical how-to-make-it features for home workshop, radio, housebuilding and automobile enthusiasts

Will History Repeat?

Early in 1925 investors were offered the opportunity to purchase shares in Financial Investing Co. of New York, Ltd., a general investment trust under management of United States Fiscal Corporation.

Between April, 1925, and April, 1928, an investment of \$1550 in 100 shares returned a cash profit of \$470 and the investor could have sold his stock at a market profit of \$875—a total three-year profit of \$1345 on \$1550 invested.

Two Dividend Increases Plus Extras

The initial dividend rate of 10% was increased to 12% July 1, 1927, and to 16% July 3, 1928. Six extra cash dividends have also been paid, making total payments on the \$10 par value shares as follows:

Year Ended	Regular	Extra	Total	Current Price of Shares
April 1, 1926 . . .	10%	2%	12%	\$18.30
April 1, 1927 . . .	10%	2%	12%	20.00
April 1, 1928 . . .	12%	2%	14%	26.25
July 3, 1928 (8 mos.)	4% (annual rate 16%)			28.25

You May Now Invest In SECOND FINANCIAL INVESTING CORPORATION

All the shares of Financial Investing Co. of New York, Ltd., having been sold at prices increasing from \$15 to \$28.25 per share, United States Fiscal Corporation now offers you shares in Second Financial Investing Corporation.

Since these two investment trusts are under the same management and alike in major particulars, it is anticipated that history will repeat itself, the new trust duplicate the success of the old and pay similar profits to shareholders.

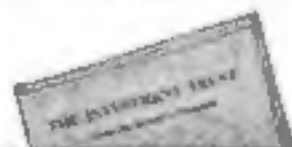
You now have the opportunity to become an original stockholder—to invest \$100, \$500 or any larger amount in Second Financial Investing Corporation before any substantial increase in price occurs.

Learn How to Make Big Profits Conservatively

It is all explained in our booklet, "The Investment Trust—from the Investor's Viewpoint," and in literature describing Second Financial Investing Corporation. Mail the coupon and profit by reading this free literature.

UNITED STATES FISCAL CORPORATION

Managers of
Second Financial Investing Corporation
and
Financial Investing Co. of New York, Ltd.



United States Fiscal Corporation
50 Broadway, New York

Please send me, immediately, your free booklet that tells how I can invest for financial independence.

Name.....

Address.....

A Shoe-string Adventure in the Stock Market

By WALLACE AMES, Financial Editor

CHAPTER I

WELL, boys, I'm all set for a killing," announced Howard Bullard, as he and three cronies sat down and began to deal the cards for their weekly bridge session.

"Don't be too sure," suggested John Snyder. "I seem to remember that you were the big loser last week."

"I wasn't speaking of winning at bridge, although there is no one in this bunch to worry me," retorted Howard. "I was just enlightening you. I am going to clean up some of this easy money in the stock market that I hear so much about."

Andy Dyer joined in. "Every one I meet these days is dabbling in stocks and if they are making one-tenth the money they talk about they'll all be sailing to the Riviera in their private yachts this winter. I've been thinking of taking a flier myself."

"What did you buy, Howard?" inquired Bob Stoddard, the fourth member of the group.

"I didn't buy anything yet," explained Bullard. "Just made up my mind today to try my luck. I'm going to open an account tomorrow."

"Stop by and pick me up," suggested Dyer. "I have a couple of thousand in the bank. I'll go down to the broker's office with you and get rich too."

"Umph!" grunted Bob. "Guess I'll tip off my friends to sell short. When you two start speculating in stocks it is the best sign that I know that the market is going to break."

"Hey!" broke in John Snyder. "did we get together to play bridge or to listen to you fellows razz each other?"

CHAPTER II

"What you going to buy?" asked Andy as he and Howard started for the broker's office at noon hour the next day.

"Guess I'll take a flier in Wright Aero," said Howard. "I've been watching that stock. Only a few days ago it was selling below 100. It has been going up to beat the band, sometimes ten and twenty points a day. It's over 200 now; wouldn't surprise me if it sold over 1000."

"Not for me," remarked Andy. "You want to make money too fast. I read in last night's paper about the merger of Chrysler and Dodge. I'm going to buy Chrysler and be satisfied with 50 points profit."

Howard Bullard bought 50 shares of Wright Aero at 290 on margin, putting up \$2,500 and Andy used his \$2,000 to margin 100 shares of Chrysler which he got at 83. And thus ends Chapter II.

CHAPTER III

"What did Wright Aero do today?"

inquired Bob Stoddard when the bunch got together a few nights later.

"Plenty," was the laconic reply of Howard Bullard. "I was cleaned out today."

"That's tough. How's your Chrysler?" asked Bob, turning to Andy.

"Great! After the merger was announced in the newspapers I guess all the 'insiders' began to sell, and one of them sold to me. The stock dropped 15 points from the price I paid. I just sent the broker another \$1,000 margin. If the stock ever gets back to near what I paid for it I am going to get out. Otherwise I'm cleaned too."

"Are we going to play bridge or aren't we?" asked John Snyder.

CHAPTER IV

"Things were a little quiet at the office this morning," said Bob Stoddard, when the trio met for lunch next day. "so I made up some figures I want to show you fellows."

"In spite of the joshing and razzing that takes place whenever our bunch gets together we are good friends and it is in the spirit of real friendliness that I am going to show you what I have done in the way of investing. I never talked about it before because you chaps knew so much before you got burned in the market that you would only have laughed at me."

"While you have been losing money in the market I have been making it. And making a lot of it too. Five years ago I invested \$1,308 in fifteen different stocks, one share of each. I did not buy on margin, but outright."

"All I knew about Wall Street was that if I went in on a shoe-string for a quick turn I'd get it—the wrong way. But we had just gone through a few years of depression and the prices of even the best securities were low. When I bought stocks I planned to hold them several years if necessary. I would receive dividends from most of them and maybe some day I could sell part or all of my holdings at a substantial profit."

"For the past five years I have sat on the sidelines with my stocks and watched the circus. Three years ago I began to notice that people of my own acquaintance, who seldom dabble in the market, were getting interested. Two years ago this public interest was greater, during the last year still greater, and during the first half of this year it was intense."

"I began to notice that friends, like you two, were plunging headlong without rhyme or reason. Although I was partly joking the other night when I said it was time to sell if you fellows were going to take a flier I got thinking it over after the game broke up and decided that it was time to cash in my profit."

"So when you were (Continued on page 5)

55

YEARS OF
INVESTMENT
SERVICE6 1/2%
BONDS

Send for the book—Learn about these bonds. Some with Tax Free and Refund Features—Offering Diversity of Investment Plus Higher Yield Satisfaction.

Use the Coupon

INFORMATION COUPON

THE F. H. SMITH CO.

Investment Securities—Founded 1873

Smith Bldg., Washington, D. C.

285 Madison Ave., New York City

Branch offices in other cities

Gentlemen—Send me copy of New illustrated book "55 Years of Investment Service."

NAME.....

ADDRESS.....

A Shoe-string Adventure
in the Stock Market

(Continued from page 4)

going like lambs to the slaughter I called up my broker and sold out my stocks. My \$1,368 investment brought me \$5,742 or a profit of \$4,374 in addition to the dividends I have received during the past five years.

"When some of the stocks I bought went way up in price they were split up, several new shares being given in exchange for one of the old. Others gave stock dividends in addition to cash dividends. So, whereas I originally bought one share of each stock, I later owned anywhere from two to ten shares of some of them.

"Here is the list of what I bought in 1923, what I paid, what I sold for and what I made on each transaction." Then Bob produced the following memorandum:

	Price Paid in 1923	Price Received in 1928	Gain
Atchafalpa.....	\$100	187	\$ 87
C. & O.....	66	182	116
N. Y. Central.....	95	171	76
Penn. Marquette.....	42	133	91
Texas & Pacific.....	22	128	106
5 Rails.....	325	803	478
Am. Power & Light.....	160	770	610
Am. Tel. & Tel.....	125	279	154
Am. Water Works.....	30	370	340
Consol. Gas.....	63	146	83
Pacific Gas & Elec.....	80	188	108
5 Utilities.....	473	1853	1380
Am. Bank Note.....	80	350	270
American Can.....	60	320	260
du Pont.....	127	1020	893
Gen. Electric.....	185	384	199
Sears Roebuck.....	70	412	342
5 Industrials.....	570	2004	1434
5 Railroads.....	323	803	480
5 Utilities.....	473	1853	1380
5 Industrials.....	570	2004	1434
15 Stocks.....	1368	5742	4374

"Recently I read a news item about automobile stocks. It showed what \$100 invested five years ago would have paid in dividends and increased market value. Between January 2, 1923 and June 15, 1928 \$100 invested in General Motors would have amounted to \$1,034, in Packard, \$1,002, in Nash, \$939, in Hudson, \$460, in Studebaker, \$200 and in Chrysler, \$1,977.

"\$1,977 in Chrysler! ejaculated Andy Dyer. Impossible! Why, I stand to lose \$2000 in that stock."

"Yes," explained Bob, "but you and I are talking about two entirely different kinds of transactions. You bought on margin, blindly, at the recent high price created by wild speculation. You were gambling for a quick turn. The market broke and you now have your last cent tied up. If it goes lower and you can't raise more margin you will be closed out as Howard was. If you had bought outright you would not have been hurt by the decline and the chances are that some time hence you could sell at a profit, even above the high price you paid.

"Believe me, boys, there is nothing in this shoe-string business for us. Divide your money between good bonds and good stocks. Once in a while you may cash in a big profit on some of your stocks, but you'll never do anything but 'feed the kitty' when you try for a quick turn.

"What are you doing with your money now?" Howard Bullard asked Bob.

"It is tucked away (Continued on page 6)

Retire
in 15 years

on your Present Living Budget

by Investing in safe First Mortgage Bonds

Follow the definite plan given in this book, and your financial independence is won.

The plan works just as surely, whether you are now earning \$1,000 or \$100,000 a year.

The way is certain—each step plainly indicated and absolutely safe—independent of luck, business genius or speculation.

Every fact has been harvested out of the 47 years' experience of Cochran & McCluer in the first mortgage investment banking business.

The plan is so simple, anyone can understand it—so definite anyone can follow it—and so certain, no one can fail.

In addition to the Financial Independence Plan and the unique budget schedule, the book gives suggestions that enable you to enjoy more of the good things of life, both while building your independent fortune and after you have attained it.

We invite the most skeptical to read this plain, straightforward, interesting book.

Send coupon. We employ no salesmen, therefore none will call.

Mail
this

Cochran & McCluer Co.
46 N. Dearborn St., Chicago, Ill.
Please send me, without obligation,
your book, "How To Retire in
15 Years."

Name.....

Street.....

City..... State.....

Cochran & McCluer Co.

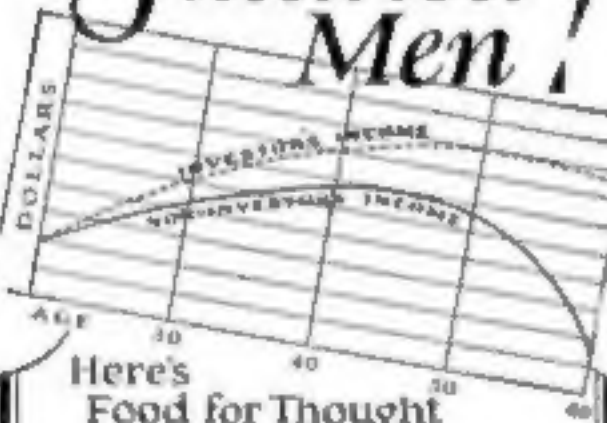
Established 1881—Never a loss to any investor.

46 North Dearborn Street,
CHICAGOHow to Work with
Tools and Wood

This book explains in a simple, straightforward manner all the processes of working with tools and wood. It takes all the mystery out of using tools and enables you to spend many interesting and profitable hours in your home workshop. All details are clearly explained.

Price \$1.00

Popular Science Monthly
250 Fourth Avenue
New York City

Salaried
Men!Here's
Food for Thought

A salaried man's earning power reaches its peak between 45 and 50. Then, gradually, it tapers off. Constant investment of a portion of your salary in Fidelity First Mortgage Real Estate Bonds maintains your income when earning power from personal efforts tapers off. Think it over.

Fidelity First Mortgage Real Estate Gold Bonds provide safety—your first consideration. Savings Plan allows for monthly payments earning 6% from the start.

How Fidelity's reputation and resources combine to safeguard every step in issuing Fidelity Guaranteed Bonds is explained in an instructive booklet. It's yours for the asking—write today for "The House Behind the Bonds."

FIDELITY
BOND & MORTGAGE CO.

660 Chemical Bldg., St. Louis
1188 New York Life Bldg., Chicago
178 Colorado Nat'l Bank Bldg., Denver

FIDELITY GUARANTEES EVERY BOND



Throw
away
that brush

Give your face a treat!



Apply
MOLLÉ

with palm of hand

No brush—no lather—no rubbing



Shave faster
than you
ever shaved
before

Without danger of cutting skin



Dry face with
towel—that's all

No steaming, lotions or powder



Makes Your
face feel
Like a
Million Dollars

Take the word of a million men

Try **MOLLÉ**



for a week at
our expense!

See why a million men have switched permanently to MOLLÉ. Find out what we mean when we say MOLLÉ lubricates the razor with a protective film of healing cream, so you can shave faster than ever before, but without danger of cutting the skin.

Above all, we want you to know how wonderful MOLLÉ makes your face feel after shaving. That "million-dollar" feeling simply can't be described.

Every MOLLÉ Shave, in reality, is a facial treatment—as refreshing and stimulating as a head-barber's facial massage.

The MOLLÉ Company
Cleveland, Ohio

Mail Coupon Today—1 MOLLÉ SHAVES FREE!
THE MOLLÉ COMPANY
Dept. 84, Cleveland, Ohio

Please send free trial and postage paid a week of MOLLÉ Shaves, to

Name _____

St. Address _____

City _____ State _____

A Whole of a Tube,
50c—at your
Drugist

A Shoe-string Adventure in the Stock Market

(Continued from page 1)

in safe bonds. When prices are lower I shall probably buy some stocks again, but whenever I do it will be for the long pull, and I will always fortify myself with a substantial proportion of my little nest egg in sound bonds.

"Investments in real estate mortgage bonds, public utility issues and shares of investment trusts and other good, home-spun investments will get you ahead surely, which is better than trying to get rich quick and not getting ahead at all."

To Help You Get Ahead

THE Booklets listed below will help every family in laying out a financial plan. They will be sent on request.

"Ideal Investments" is the designation universally accorded Smith First Mortgage 6 3/4% Bonds which carry attractive tax refund features. A history of the House and information relative to their bonds and the safeguards that surround every issue they offer may be obtained by addressing the home office of The F. H. Smith Company, Smith Building, Washington, D. C.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1188 New York Life Building, Chicago, Ill.

"The Investment Trust from the Investor's Viewpoint," presents an explanation of this form of investment in easily understood terms, illustrated with some interesting examples of how the general investment trust will help the man with \$100 or more to get ahead. Published for free distribution by United States Fiscal Corporation, 50 Broadway, New York. Ask them for Booklet IT.

How to Retire in Fifteen Years is the story of a safe, sure and definite method of establishing an estate and building an independent income which will support you the rest of your life on the basis of your present living budget. Write for the booklet to Cochran & McCluer Company, 46 North Dearborn St., Chicago, Ill.

How to Get the Things You Want tells how you can use insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 318 Elm Street, Hartford, Conn., will send you this booklet on request.

The Guaranteed Way to Financial Independence tells how a definite monthly savings plan will bring you financial independence. Write for this booklet to Investors Syndicate, 100 North Seventh Street, Minneapolis, Minn.

The Making of a Good Investment tells how 6 3/4% can be made on investment in First Mortgage Bonds in units of \$50, \$100, \$250, \$500 and \$1000; how the bonds are protected and how simple it is to purchase them. For a copy of this booklet address United States Mortgage Bond Company, Limited, Detroit, Michigan.

First Mortgage Safety with many new Conveniences

GUARANTEED United First Mortgage Bonds offer you the safety of a well-secured first mortgage—without any collection or supervision worries.

Decide now to find out more about these tried and proven investment bonds—how they may be purchased out of income—how they will help you reach your financial goal.

Write for further information today.

**UNITED STATES MORTGAGE
BOND COMPANY**

Howard C. Wade, President

365 U. S. Mortgage Building
Detroit, Michigan

Resources more than \$20,000,000

In Canada: United Bond Co., Ltd.,
Toronto and Windsor, Ont.



Don't fumble and grumble

AN EVEREADY Flashlight will spot a screw-slot in the dark so that a near-sighted man couldn't miss it! Great for little jobs of careful adjustment. And takes half the grief out of any other tedious, time-wasting work that's got to be done in the dark.

An Eveready Flashlight will set you right with the flashlight habit. That implies that you know your batteries, too, and always load your flashlights with genuine Eveready Batteries. Experience will prove that you can't beat 'em. They hold an extra share of endurance that keeps them coming through with plenty of light long after the ordinary kind are in the scrap pile. Loaded to the top with usefulness, they are, and when you reload a flashlight remember that. Get genuine Eveready Batteries always.

A definite program for getting ahead financially will be found on page four of this issue

GASOLINE + ETHYL = *high compression performance*

YOU are hearing much about "high compression"... "high compression engines"... "high compression fuel"... "high compression performance."

"What," a great many car owners are asking, "does 'high compression' mean to me?" Here is a simple explanation:

Each cylinder of your engine may be likened to a muzzle-loading gun. The cylinder is the gun; the piston is the bullet; and the mixture of gasoline and air is the powder charge.

The tighter you pack the powder charge in the gun before firing, the greater the force to the bullet. Similarly, the tighter you squeeze—or compress—gas vapor and air in the combustion chamber before ignition, the greater the force of the piston's stroke. In other words, the higher the compression the greater the power.

Higher compression in a gasoline engine is obtained by decreasing the size of the combustion chamber—either by mechanical design or by carbon formation.

Up to the advent of Ethyl Gasoline, the compression of automobile en-

gines was limited by the compression limits of gasoline. For gasoline is not a perfect fuel. It explodes too soon ("knocks") and loses power when squeezed beyond a certain point.

That is why General Motors Research Laboratories developed ETHYL fluid, a compound which controls the combustion rate of gasoline so that as engine compression is raised the "knock" is eliminated. And that is why oil companies are mixing ETHYL fluid with gasoline to form *Ethyl Gasoline*—the standard high compression fuel.

Within the last year, car manufacturers have been able to produce new models of higher compression and greater power. *But the most immediate benefits of Ethyl Gasoline are found among the millions of owners of cars of ordinary compression, because with its use in such cars carbon becomes an asset.*

Ride with ETHYL. See what a great difference it makes on hills and in traffic. No "knocking." Less shifting. Faster pickup. Stop at an ETHYL pump today—it bears the emblem shown at the left.



ETHYL GASOLINE CORPORATION, 25 Broadway, New York City. 56 Church St., Toronto, Ont., Can.

ETHYL GASOLINE

How the New Radio Sets Are Tested

By using this apparatus, a radio set's efficiency can be measured.

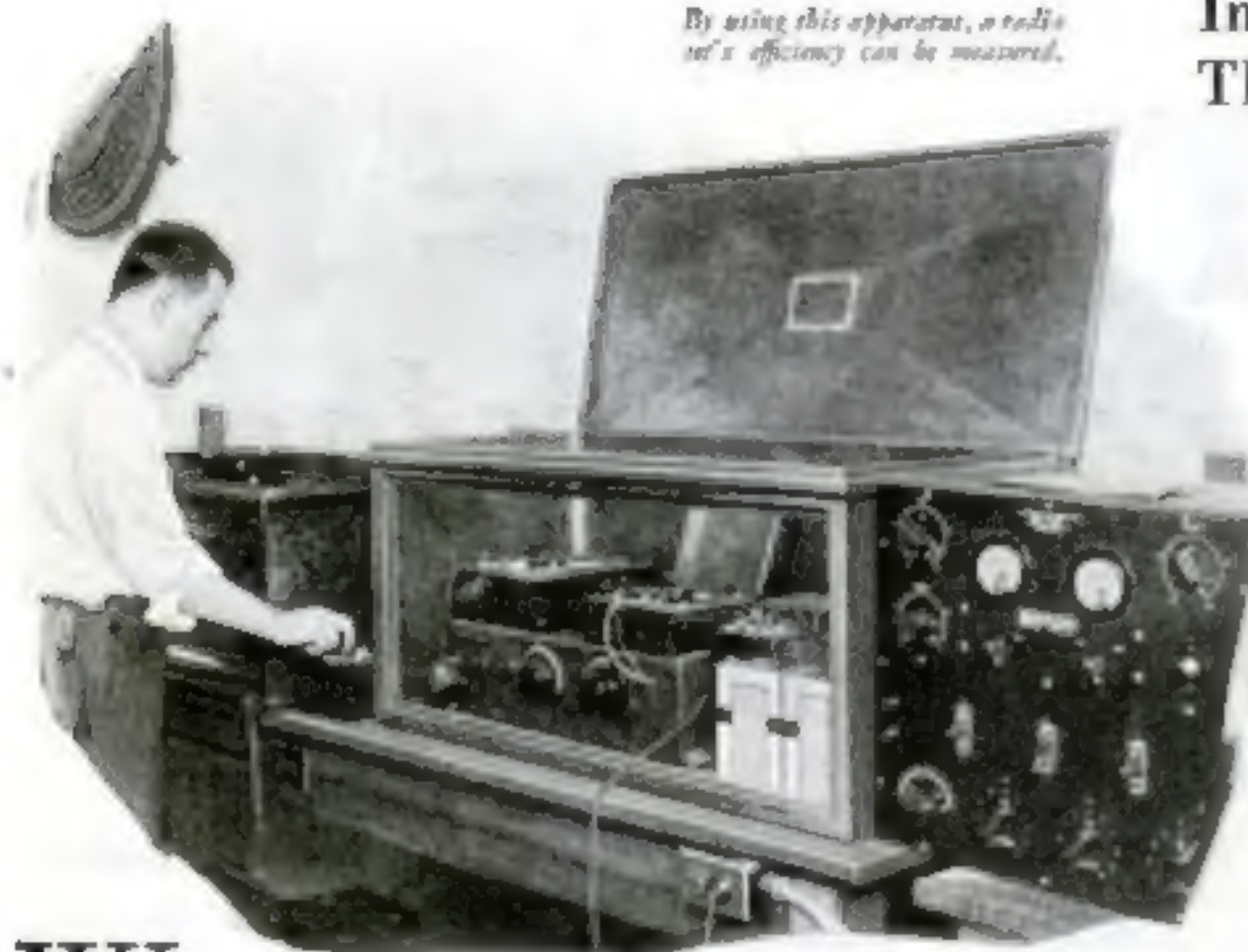
Institute Puts New Sets Through Vigorous Tests

By

Alexander Senauke, M. E., E. E.

Assistant Director

Popular Science Institute of Standards



WHILE radio engineers in industry have been making real strides in designing radio receiving equipment that comes closer to approaching the ideal, the Popular Science Institute of Standards has been concentrating at the same time on the development of more discriminating and precise tests for radio sets.

From the very first, all Institute tests of radio products have been of such a nature as to do away with the inaccurate human ear as a means of judging the merits of equipment. Always, quantitative or numerical measurements have been obtained which show, by the movement of a needle across a definitely marked scale, just what a product will or will not do. By devising tests that provide such measurements, the Popular Science Institute has had a real basis for determining the worth of products without personal opinions or guesswork entering into the matter in any way.

HOWEVER, there has been one point that has been causing difficulty. While test results definitely determine a product's performance, there have been no means of measuring these test results except by comparison. This was because there were no established performance units. Now, however, the standardization activities of engineering societies have provided absolute units for such measurements based on the actual action of incoming radio waves in producing an audible "signal" or sound at the loudspeaker. To find out the sensitiv-

ity, the selectivity, or the fidelity to tone of a radio receiving set, these measurement units are applied, and comparison as well as human hearing and judgment is eliminated from radio testing as carried on by the Popular Science Institute of Standards.

To make such measurements, the laboratory apparatus must duplicate in miniature the phenomenon that takes place in real radio transmission and reception. The carrier frequency voltages generated must be of a magnitude comparable to the voltages generated in actual broadcasting stations; provision must be made for known modulation with any of the components of speech and music.

THESE modulated radio-frequency voltages must be artificially reduced in strength in the space of a few feet, as though they had traveled a thousand miles or more.

The excess power must be thoroughly confined so that it cannot affect the most sensitive receiver while under test. In addition, a dummy antenna must be provided that will be electrically equivalent to the usual outdoor antenna, and suitable thermo and vacuum tube meters must be provided to give an accurate visible record of the receiver's performance.

The development of such apparatus is quite obviously a task of great magnitude. The above photograph shows in experimental form part of the testing apparatus that was developed by The Institute's staff to conform to these requirements.

Repeated tests and measurements made on a number of radio receivers of varying type indicate that this apparatus satisfactorily meets all requirements as to consistency of results, accuracy of determinations, and ability to test receivers of different design and sensitivity levels. The use of this apparatus provides information of a very definite nature regarding the set which is under test.

These comprehensive, accurate, and complete tests safeguard the readers of POPULAR SCIENCE MONTHLY against the purchase of inferior radio equipment. In fact, manufacturers value The Institute's tests so highly that we are frequently called on to test and report on experimental models before they are put into production.

Lists of equipment approved after test by the Popular Science Institute of Standards can be had free on request. Readers who are investing in a new radio outfit will find helpful the booklet "What the Radio Buyer Should Know." Besides full advice on buying and installing, nine pages of this booklet are devoted to operating hints that will enable one to get the best results from his radio outfit. Price 25 cents a copy. Popular Science Institute of Standards, 250 Fourth Ave., New York, N. Y.

Popular Science Monthly GUARANTEE

The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Standards.

POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by POPULAR SCIENCE MONTHLY. THE PUBLISHERS

This grainless wood is workable almost beyond belief!

Can be cut out, punched, die cut and milled. Very dense and tough. Highly resistive to moisture. Has a smooth, attractive surface on the face side, and requires no paint for protection. Also takes any finish beautifully. Send for large free sample.



FOR STORE FIXTURES

American Industry is now pretty well aware of the fact that there is on the market a genuine all-wood board that is grainless, that won't crack, split or splinter, and that is highly resistive to moisture.

But there are still many manufacturers and mechanics who do not fully appreciate the truly remarkable workability of Masonite Presdwood.

Containing absolutely no foreign substance of any kind, Presdwood cannot damage tools. It can be used on saw, planer, sander, shaper. It can be cut out, milled, die cut and punched. It also assures economy in cutting panels to size. In fact, it practically eliminates all waste in cutting.

Presdwood has uniform strength, too. It is highly resistive to moisture. It is very dense and tough. It has a smooth attractive surface on the face side, requires no paint for protection, and takes any finish beautifully.

Wide, wide range of uses

Although it has been on the market only two years, Masonite Presdwood is already in use in scores of industries all over the country.

Presdwood is used extensively in paneling—alike in fine Southern homes, in stores and offices of the East and the Middle West, and in summer cottages of the great North woods.

It is being used in the manufacture of kitchen cabinets, medicine chests, cupboards, tension boards, work-bench tops, tables, desks, book cases, linen chests and china closets.

Toy manufacturers are large users of Presdwood. It is serving in hospitals as bedroom screens and as

invalid trays. And it is especially efficient for table tops.

Laundries, bakeries and dairies are using Presdwood quite extensively. For example, it goes into the making of clothes hampers. And because of its strength and resistance to moisture, it is being built into bread boxes and patented dairy containers.

A number of Chicago railroads are using Presdwood as dust arresters for journal boxes; various foundries are finding it an ideal material for cooling trays for hot castings; it is also going in to the production of packing cases.

New and unexpected uses

Just recently a manufacturer of portable billiard tables became interested in Presdwood. He is especially impressed by its stout resistance to wear.

A manufacturer of electric light globes is putting Presdwood to a novel use. He bores holes into it to fit his bulbs, and thus they are held tightly while being etched.

Presdwood is also being used to line ventilators and elevator shafts—because of its excellent anti-rattle qualities.

And before this advertisement reaches your eye a number of other Presdwood uses will have been discovered—some of them entirely unexpected uses.

Write today for a large free sample of Presdwood and find out what it will do for you.

MASONITE CORPORATION

Sales Offices: Dept. 1298, 111 W. Washington St.
Chicago, Illinois



FOR PANELING

FOR SIGNS



Mills, Leonard, Mississippi

Masonite
PRESWOOD
Made by the makers of
MASONITE STRUCTURAL INSULATION

FOR RADIO CABINETS



Our Readers Say—



A Shake-up in the Hall of Fame

"I REALLY was not aware that POPULAR SCIENCE indulged in humor as a reading of your list of thirty-one geniuses would indicate. Certainly, if this list is to be regarded seriously, it is an insult to mature intelligence. Thirty-one geniuses, of whom at least thirteen are American—my dear sir! In the compiler's obvious zeal for a 'hundred percent American' list, I cannot understand why Horatio Alger and Scar-Face Al Capone were omitted."

"For example, Woodrow Wilson is preferred to Lenin or Mussolini. Daniel Webster to Burke, Bright, or the ebullient Pitt. U. S. Grant to Luxemburg, Marlborough, Frederick the Great, or Allenby—and—just save the mark—Horace Greeley and Edgar Allan Poe to Shakespeare, Milton, Burns, Keats, Goethe, Heine, Musset, or Hugo."—C. M. N., Dominion, N. B., Can.

"In your selection of geniuses, you failed to remember that somewhere there is a country called Russia. This country had, and has today, some great masculine figures, namely:

Tolstoy, Tchaikovsky, Trotsky, and many others. Why be partial?"—R. E. Los Angeles, Calif.

"I hardly see how Isaac Newton can be left out of any list of geniuses. He was one of the most nar-

velous men of all history. And I see no reason for placing Grant in a list of thirty-one, and leaving out Charles P. Steinmetz."—F. B., Caliente, Nev.

"I'd omit Napoleon Bonaparte and substitute Nikita Lenin. I'd also omit Prince Bismarck, Charles Darwin and Alexander Hamilton, and substitute Marshal Foch, inventor Tesla, and Dr. Voronoff."—F. V. H., Westport, Ky.

"As we are going to an age of aviation, there will be many votes for Charles Lindbergh, and the next ten years may prove them correct."—J. A. F., Tusden, Ind.

Bang!—The Last Word

"WELL, then, you may say to Mr. Lucky for me that this ways takes at least thirty-one good men to equal one woman. Enough said."—An Old Cat from Boston

Thank You, Sir Jagadis

"I THANK you for the article, 'Plants That See, Feel and Think,' regarding my researches. I think it is one of the very best that has been written."—J. C. Bose Calcutta

Why Not?

"I WONDER if you are aware that here in the University of California Experiment Station a plant physiologist has just succeeded in growing roses, dahlias and many other plants without any soil whatever. He simply plants the seedlings in water in which he has mixed certain chemicals needed for their growth. Hundreds of the plants have thrived and blossomed on this artificial chemical food."

"Some time ago in your magazine I read a discussion of the possibility that some day people may eat nothing but tablets of synthetic

food. Apparently the idea isn't so far fetched as I thought at the time. If plants can live on it, why not people?"—N. D. H., Berkeley, Calif.

The Customers Speak Up

"IF YOUR magazine really had as much useful stuff to read about for twenty-five cents as Montgomery Ward has in their catalogue for nothing, I might be a regular subscriber."—Scotchy, Madison, Wis.

"Perhaps you would like to hear from a satisfied customer. Your articles are clear and correct. Your fiction is clean and interesting—the whole family reads it. Your aviation

articles are excellent. As the world progresses, you progress with it."—R. H. B., Norway, Minn.

"Add my vote against so much aviation reading matter. For just folks like me, flying is about as important as wings on a hen. It thrives only on printer's ink."—N. C., Memphis, Tenn.

"Just a line to let you know how I've enjoyed reading 'Flowers Who Huh Caterpillar Club,' by Nell Clarke, in your July issue. I must say that it's worth while."—J. O., Bronx, N. Y.

"There is a personal touch to your magazine that I find refreshing."—C. J. S., San Luis Obispo, Calif.

A Chance for a Birdie

"WE ARE in the field for a machine that will stamp names and advertisements on golf balls, and we are wondering if you will help us get in touch with inventors. Several machines have been designed to do this, we understand, but have not proved satisfactory. There are several on the market now that mark the balls by hand, but this is a very slow process. What we desire is a machine that will stamp printing matter on the



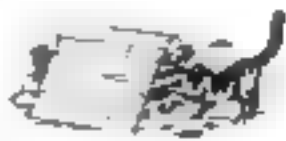
golf balls automatically at the rate of 100 or 200 an hour. The machine must be able to use types of two sizes, in colors, and to print clear around the equator of the golf ball. The faster it prints, the better we'll like it.

This is a problem that should challenge the spirit of inventors. —S. W. Co., Boston, Mass.

Eli and the Chicken

"PERHAPS other readers will be interested in this story of how Eli Whitney got his first idea for making the cotton gin."

"While standing by a crate of chickens, he saw a cat trying to pull a chicken out between the slats of the crate. The cat was able only to draw out feathers. In thinking the thing over later he saw the same scene with these changes. Instead of the chicken he saw cotton with seeds too large to go through the slats. Instead of



the cat, he saw a revolving spool with projecting bars pulling the cotton out, leaving the seeds behind."—J. F. D., Cincinnati, O.

What Is Your Answer?

"HERE is an interesting phenomenon I observed the other night. If a glass of carbonated beverage, ginger ale, for instance, in which there is loose ice floating, is jarred slightly, so that the ice is made to strike the sides of the glass, a certain tone is, of course, given out. Now, if the glass is shaken slightly but rapidly for a few seconds, this tone will be heard to rise perhaps as much as a half tone."

"The explanation of this seems to me to be that the shaking liberates those bubbles of carbon dioxide which were clinging to the sides of the glass. When these have passed out of the solution, the volume of the liquid is diminished, causing the air to create a higher tone."

"I should like to know the opinions of some others on this."—R. G. D., Baltimore, Md.

A Bomb from Chicago

"I NOTE in the July issue, on page 38, a heading 'Gasoline Tax on 40 States.' For once you are wrong. The number is only 43 (for Illinois has no tax). Maybe you feel that we are not part of the U. S. But we are, and proud of it."—W. H. J., Chicago, Ill.

Even Griffith Never Had Such Praise as This

"THAT movie

the 'Movie Maker' in a d d e turned out to be one tremendous spectacle, judging from what I can gather. Pre-

historians, murderers, Cr. saders, Swiss villagers, and doughboys, all bashed up and shot. Anyway, I see that the Movie Maker finally married his cutie. Thank God that's over."—Helen H., Philadelphia, Pa.

"I've lived in this movie town for eight years now, and I can say that 'The Movie Maker' was a realistic account of the way in which more than one determined young man has made his fortune in the game. Give us some more as good."—L. S. D., Hollywood, Calif.

More Model Ships Ahoy!

"I WOULD like to suggest to Captain McCann that his next model be a modern ship, for instance, the schooner 'Blennise' which won the international schooner race for several years."—H. B. R., North Sydney, Nova Scotia.

"I have built two yacht models, one Spanish galleon, and a thirty-inch single stick ship, all from your blueprints, which contain every detail necessary."—C. H. S., Aniak, Alaska, U. S. A.

"Please tell me if Captain McCann is going to make any more ship models. I have been interested in his many articles, and hope he will continue to make them as worthwhile as your featured articles."—W. J., San Antonio, Tex.



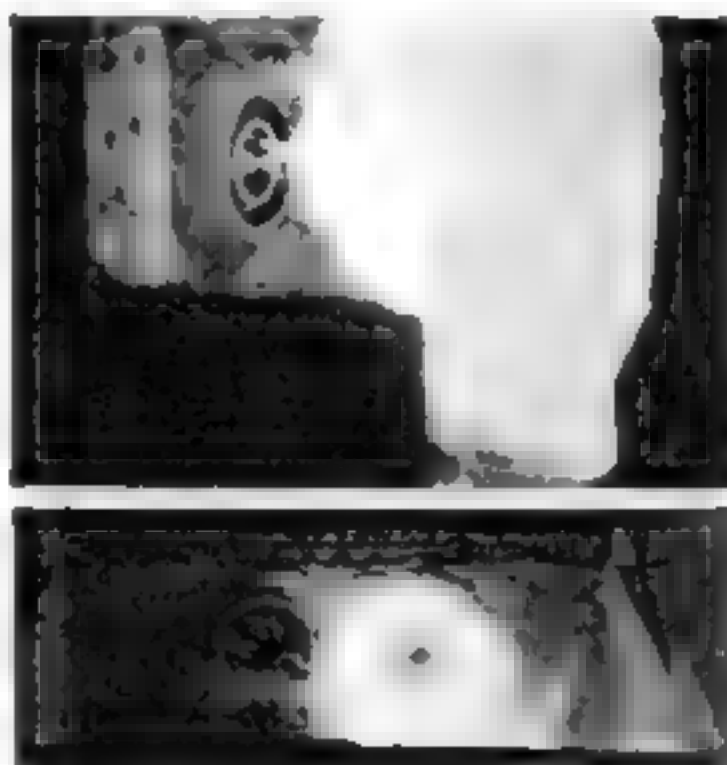
With ELECTROL, you're sure of Correct Installation

Factory training of installation men is one of the many reasons why you are assured completely satisfactory performance from the Electrol Automatic Oil Burner.

The men who install Electrol Oil Burners are trained at the factory. They are given thorough instruction in the correct methods of fitting Electrol to each type of heating plant.

Moreover, they are required only to install the burner—not to assemble it too. Electrol burners are shipped to the dealer completely assembled just as they are when they pass their final rigid test and inspection at the factory. Thus, you have double assurance of dependable operation right from the start.

Correct installation is part of the purchase when you order an Electrol Oil Burner. It has helped us and our dealers to build a successful business. It has contributed much to the satisfactory performance of Electrols in



Above: A typical installation. Left: Two actual photographs of Electrol combustion. Note remarkable flame diffusion in larger illustration, also how spark is directed into vapor. Lower illustration is a TD installation with outlet of burner on inside. Note spark showing on left and excellent combustion cone on right.

many thousands of homes over a long period of years.

Quiet . . . All-Electric . . . Entirely Automatic, Electrol is the embodiment of advanced engineering principles . . . It employs mechanical fuel atomization and positive continuous electric spark ignition. The spark is blown into the spray of oil vapor instead of allowing the oil to be blown into the spark. Thus carbonization at the electrode points is prevented.

The pump, of exclusive Electrol design, develops enough force to draw oil directly from the main reservoir and deliver it at the nozzle at operating pressures. No auxiliary tank or booster pump is necessary with Electrol.

Every phase of Electrol's dependable operation is regulated by *The Master Control*. Standing watch like a living sentinel always at the furnace door, *The Master Control* safeguards comfort day and night.

Electrol offers you constant comfort without attention and all the conveniences of modern automatic heat at its best. Wherever it is sold, you will find a complete oil heating service backed by a sound, large and growing manufacturing organization.

Made in sizes for every type and size of building, large or small. Can be purchased on convenient monthly terms. May we send you our booklet "The Master Furnace Man?" Use the convenient coupon.

Electrol Inc. of Missouri
180 Dorcas St. • St. Louis, U. S. A.



A Blue Book of Electrol Owners would read like the actual records of America's 2 million best heating homes of the country's finest homes.



The Master Furnace Man

ELECTROL

Listed as Standard by the Underwriters' Laboratories and bears their label
Member Oil Heating Institute. Approved by Popular Science Institute of Standards

Electrol Inc. of Missouri,
180 Dorcas St., St. Louis, U. S. A.
Gentlemen: Please send your book, "The Master Furnace Man," and details of the Electrol Oil Burner.

Name
Street and No.
City State



Making Over the Movies



The Movietone film presenting in America for the first time George Bernard Shaw speaking. On left edge of the film is the photographic record of his voice.

ENTIRE Film Industry Being Revolutionized
As 400 Theaters Show Pictures That Speak
and First Great Full-Length Talking Drama
Is a Reality—Complete Musical Comedy Is
Arranged For and in a Few Months It May Be Pro-
duced in a Thousand Auditoriums—How Remarka-
ble Inventions Give Voice and Music to Silent Screen

By ALDEN P. ARMAGNAC

WILL talking movies, newest competitor of the silent drama, eventually usurp its place? That is the question on the lips of everyone who has watched its phenomenal spread throughout the country. Today the "movies you can see and hear" are presented in more than 400 theaters—from the Roxy in New York, seating 6,200, to the Sun Tower in Los Angeles, with a seating capacity of 900—and by the first of the year, it is expected that such theaters will number a thousand. For the first time in their spectacular history the "movies" are being made over.

Walk up New York's Broadway from Times Square, after dark, and what do you see? At the Gaiety Theater electric lights proclaim "*Fazio*—a Fox Production with Movietone Symphonic Accompaniment." "See and Hear George Bernard Shaw on the Movietone" urges the Globe Theater just beyond. The Mark Strand invites you to come in and see *Miss Information*, a Vitaphone playlet, and

Movietone newsreels. And the Warners' Theater presents "*The Lion and the Mouse*, a Warner Vitaphone picture with Lionel Barrymore and May McAvoy and other Vitaphone features."

The smaller cities and towns have talking movies, too. Aberdeen, S. D.; Aberdeen, Wash.; Akron, O.; Albany, N. Y.—the list of towns and cities that have theaters equipped to show them reads like an encyclopedia.

"In five years there will be no silent pictures," says Jesse L. Lasky, vice president of the Paramount-Famous-Lasky Corporation. "Motion pictures are as much entitled to embrace sound as is the stage," D. W. Griffith, independent motion picture producer, declares. "We will have to learn when to add the whistles and sirens and fire-wagon gongs and when to leave them out," cautions Al Christie, maker of Christie Comedies. "We expect soon to be selling assorted noises with our films," predicts Hal E. Roach, comedy producer. And John Ford, director for Fox Film Corporation, says of the use

of sound in movies: "The field of its artistic possibilities is not yet furrowed."

Despite popular impression, all-talking dramas are a new thing—so new that New York saw the first one, *The Lights of New York*, only a few weeks ago. Previously talking movies had been made with only a part of their length featured by audible dialogue, and the rest often filled out with a sound-recorded orchestral accompaniment.

IT IS hard to say just when talking movie experiments began. As early as ten years ago, San Francisco saw the second act of *The Merry Widow* rendered as a crude sound movie, and even before that experimenters had tried to adapt sound to the then-silent drama. Modern talking movies, however, date definitely from August 6, 1926, when the showing of *Don Juan* with Vitaphone orchestral accompaniment in New York heralded the first public demonstration of this new process. It had been developed in the Bell Telephone Laboratories. Mean-



Paul Hodge recording the voice of Raquel Torres, as a test for her in a talking film role.

while another process, the Movietone, was being rushed to completion. Credit for its development is usually given to Earl L. Sponable, technical director of Fox Movietone. The first public demonstration of this invention took place in New York, January 21, 1927.

Some of the largest motion picture companies are licensed to use talking movies with either system, both of which are manufactured by the Western Electric Company. These include the Paramount-Famous-Lasky Corporation, the Metro-Goldwyn-Mayer Corporation, the United Artists Corporation, Warner Brothers, the Fox Film Corporation, the Christie Film Corporation, and the Hal Roach Studios.

Meanwhile a third process, the Photophone, was being developed by the Radio Corporation of America in the laboratories of the General Electric Company. This process is used by other motion picture producers, including the Pathé Film Company and the P. B. O. Studios, to make full length pictures with the accompanying music. These three systems are the best known. But there are others, including, to mention only a few, the Cortellophone, and the Vocafilm. And in England a number of theaters are showing talking films made by the De Forest Phonofilm process.

POPULAR SCIENCE MONTHLY has described in previous issues the technical features of the three important processes. Suffice it to say here that all use one of two basic principles. Either the sound accompanying a drama is recorded on a wax disk like a phonograph record—as in the Vitaphone process—or it is photographically recorded through an ingenious system on the motion picture film itself, as in the Movietone and Photophone processes. When the finished film is pro-

jected in a theater, sight and sound are perfectly in step, the latter reproduced electrically through giant loudspeakers hidden behind the screen.

Several kinds of sound pictures now in vogue illustrate the gradual development of talking movies; each is a step in their evolution. First there are silent full-length pictures with orchestral accompaniment; they are popularly known as "synchronized movies," although the term



Voice-recording device of the Vitaphone. Each disk records speech for one reel. The total arm is floated laterally in air.

really includes talking movies as well. Then there are short vaudeville sketches featuring music or monologue, audible newsreels, talking picture interviews with famous persons. Next the full-length



Miss Torres, actress, seeking a talking movie role hands John Lancaster, studio casting director, a record of her voice.

films with short snatches of dialogue, and finally the all-talking drama.

The first variety, dispensing entirely with a theater's own orchestra, supplies the smallest theater with a program of the finest music. The score is recorded when the film is made. Widely known musicians and appropriate selections are chosen and arranged in perfect unity.

Vaudeville specialties in the "talkies" are proving a field for cautious producers trying out their apparatus and equipment. The other night I sat in a New York theater and watched an audience witness such a program. An opening number by a jazz orchestra, seen on the screen and heard playing, evoked applause that ended suddenly when the applauders realized that the musicians could not hear their own music. Another orchestra melody met with silent response. But when a pair of young women sang from the screen in close harmony, the theater-goers spontaneously burst into applause again, a pair of comedians convulsed them with their quips, and after an opera singer had concluded the final selection the spectators abandoned all restraint and a roar of hand-clapping swept the theater. It was an impressive demonstration, for it brought home the possibility that here was a way of shipping "canned" vaudeville, talent of the first water, to the most remote theater in the country.

AND at least one motion picture producer is preparing to transport bodily an entire musical comedy to the talking movies. *The Desert Song*, a light opera that has run in New York, Chicago and the West, is to be filmed by the Vitaphone and released within a few months.

Meanwhile the adaptation of musical drama to the screen has brought about an interesting legal quandary. As this is written, a test case is pending over *Show Boat*, a Ziegfeld musical comedy based on the novel by Edna Ferber. A film company bought the movie rights before the musical comedy was made, now it claims as well the Movietone rights. Ziegfeld seeks to halt the production on the ground that every film shown would be a mechanical competitor of his show.

By recording the likenesses of great men in the talking film, it will be possible for future generations to see them while they talk. Among the first to take advantage of this opportunity are Calvin Coolidge, Col. Lindbergh, and George Bernard Shaw, noted Irish author.

In the first full-length talking movie, *The Lights of New York*, a Warner Brothers production, there is not a single printed subtitle in the seven reels. Spoken words introduce the characters in turn. A jazz band plays in a cabaret scene; a man sings and spectators sit at tables and converse in animated and audible

tones. And, as an example of the fidelity of talking film reproduction, a man enters through a door, and as he closes it the sound of music coming through the doorway dies away.

Meanwhile players are being selected for *Behind That Door*, another full-length talking drama, by the Fox organization. This picture, it is announced, will use dialogue and sound effects throughout.

Talking movie dramas have created a host of new problems for the producer to face. Not all of them are technical. Recently a Pennsylvania court held that the State Board of Censors must approve dialogue as well as scenes before a talking film could be released. Another more serious question facing producers is that of the foreign rights of a talking film. Obviously a film made in America, in which the characters speak in English, can be exported only to Great Britain. "We'll worry about the French and Spanish rights later," says Ben E. Jackson, executive manager in charge of Movietone production. And Roy J. Pomeroy, technical director of the Paramount-Famous-Lasky studio, predicts as an outgrowth of internationalized talking movies "universal knowledge of two or three common languages."

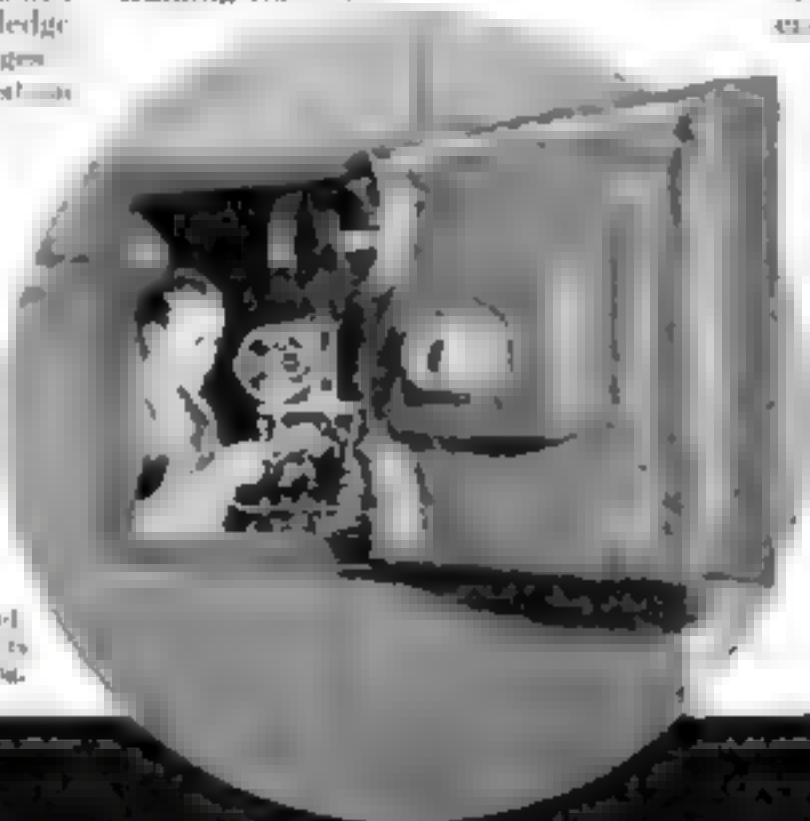
Another problem concerns the question of "synthetic music." The American Federation of Musicians, comprising 158,000 members, has just voted a defense fund of \$1,500,000 a year to combat the introduction of sound-track devices in theaters. "We are not opposed to talking movies," its president, Joseph N. Weber, declared recently, "but if the machines are used as a substitute for vocal and orchestral music in the nation's theaters they will be a menace to our cultural growth."

Musicians in the world protest that their recording of music is being

His views are not shared by S. L. Rothafel, or "Roxy," owner of the largest talking-movie-equipped theater, and an honorary member of the Federation. "This is a new sign of progress," he says, "and musicians should hitch it to their own uses."

The stage has an important link with its new-born cousin, the talking movie. Its graduates are already trained to play in sound films, dramatic critics point out that players with previous stage experience, such as Lionel Barrymore, to mention but one, give far more pleasing performances than others whose voices have not been specially trained by long practice.

FAR-SEEING actors and actresses in the California film colonies are already rushing to voice culture schools. The voices of some stars are hopeless for talking movies, but others, particularly those with stage experience, are well suited to the new systems. The First National studio has instituted compulsory voice classes for its players and Fox and other producers plan similar training classes.



Making a street scene in the all-sound Vitaphone drama, *The Lights of New York*. At the right is the camera housed in its soundproof booth that prevents its clicking from marring the speech of the actors. In this scene of the talking drama newsboys cry their extras. In the seven reels of this picture there is not a printed sub-title.

When players are selected today for a talking movie cast they are given both screen and voice tests. One Western technician, John Hodge, has even arranged to provide job-seeking players with test records of their voices, to be submitted to casting directors, thus dispensing with the delay of a voice trial.

It is said that G. Bernard Shaw, whose "speaking likeness" recently greeted Americans from the screen, insisted that he be permitted to see and hear his pictured interview before its release. But when the picture was shown and he heard even the twittering of birds in his garden where the picture was made, he approved at once.

Less composed was Alfred E. Smith, Democratic nominee for president, when he recently posed. Spectators saw him take out his handkerchief and mop his brow as he complied with the photographer's request. And Michael Hainisch, President of the Austrian Republic, was frankly overcome with consternation not long ago when the talking movies recorded an address to the Franz Schubert Seminary. President Coolidge, veteran of many a radio address and camera encounter, faced the sound camera unperturbed. But the thoughtless slip of another prominent political figure spoiled one photographer's whole day. When his speech, prepared in advance for newsreel distribution, was run over in the projection room, it was discovered that at one point he had said "facilitate" when he meant "elicitate." The film was released without the talking part.

ONE concern, making newsreels of sound films, has a special field outfit used for talking interviews and newsreels. This picks up with the picture such sounds as the hum of an airplane's motor or the tramp of a marching army. This ingenious apparatus is transported in a motor truck and with it go a camera man and a "sound man."

Co-directors are necessary for talking movies. One attends to the picture, the other, known as the technical director, to the sound. The latter sits at what is known as a monitor desk, on a platform twenty-five feet above the stage, and controls the entire electric recording system. Through a heavy glass plate that no sound penetrates he commands a view of the whole stage, and four large wooden loudspeakers behind him tell how the sound effects are being recorded. His only communication with the picture director is through a miniature telephone system.

Whether the venture into this fascinating new field of movie art turns out to be a gigantic success or a colossal failure remains to be seen. But the men who head the big companies are of the conviction that the talking motion picture is revolutionizing their business.

Lost in the Arctic



Lost photograph of the *Italia* taken at Spitzbergen just before her start on the North Polar flight on which she met disaster. Above: The *Italia* flying over Mount Lee.

The Whole World Watches Heroes of Modern Invention Wage Grim Battle to Save Nobile's Men from the Ice

By EDWIN KETCHUM

IN A banquet hall at Oslo, Norway, a few weeks ago, famous explorers of the Arctic gathered to honor Capt. George R. Wilkes and his old friend, Lieut. Charles Jackson, for their daring airplane crash from Alaska across the Polar Sea. Among the guests was Capt. Roald Amundsen, discoverer of the South Pole and hero of the polar flight of the dirigible *Norge* in 1926.

On this banquet broke the news that the airship *Italia*, in which Gen. Umberto Nobile has just completed history's fourth conquest of the North Pole, was many hours overdue in a battle with a storm on her return trip. The dirigible's radio, which miraculously had kept the world in touch with her progress, now was ominously silent. There was fear that disaster had befallen the ship and her crew of sixteen men lost somewhere over the desolate sea of ice between Spitzbergen and the Pole.

Italy had called upon the government of Norway to lead the rescue, and Norway now appealed to Amundsen.

A tense moment followed. Every man

recalled the bitter quarrel that had grown between Amundsen and Nobile following the fall of the *Norge*. What would Amundsen answer? All eyes turned to him.

The weather-worn face of the grizzled Viking betrayed no sign of inward conflict. "Tell them," he said, "I am ready to start."

That stirring scene—the veteran explorer offering his life to aid an estranged rival in peril—opened a titanic drama of rescue—an epic of valor, of mechanical and inventive mastery surpassing anything in the records of adventure. The events which have followed the *Italia* disaster form a story of stark tragedy and superhuman deeds which, at this writing, still hurries on to a climax no man can guess.

For weeks, now, through the magic binoculars of radio, the world has witnessed a bewildering succession of heroic episodes in the Far North. The story of



Capt. Roald Amundsen, leader of the Arctic expedition which has rescued Nobile's men from the ice.

Nobile's rescue, and of the uncertain fate of his scattered companions, has become a story of the most dramatic.

Amundsen, equipped with radio, in the role of messenger and savior, guided flying rescuers to the

little floating ice cake where the *Italia* crashed from the sky, and where Nobile and his pitiful handful of survivors struggled for their lives. More millions imagined the fate of the seven blown away in the wind-driven balloon, of the three who set out on foot in search for land. They anxiously watched as the nations of Europe mobilized men and machines—dog sleds, ice-breaking ships, warships, airplanes, and seaplanes—to penetrate the ice locked wilderness. They saw fearless flyers from many lands wing northward on a seemingly hopeless search.

Then, from afar, they beheld the grim battle—men with their modern machines and inventions, pecking and stooping to



The crew of the *Citta di Milano*, base ship of the Nobile Polar expedition, clearing a road through the ice for the landing of supplies at Kings Bay, Spitzbergen. It was this supply ship that received by radio the first news of the *Italia*'s crash, and of Nobile's plight.

loosen the cold hand of the Arctic giant from the prisoners it clutched. They saw Amundsen and the French Navy pilot, Rene Guilhaud, fly northward, to be swallowed, too, and lost in grim silence.

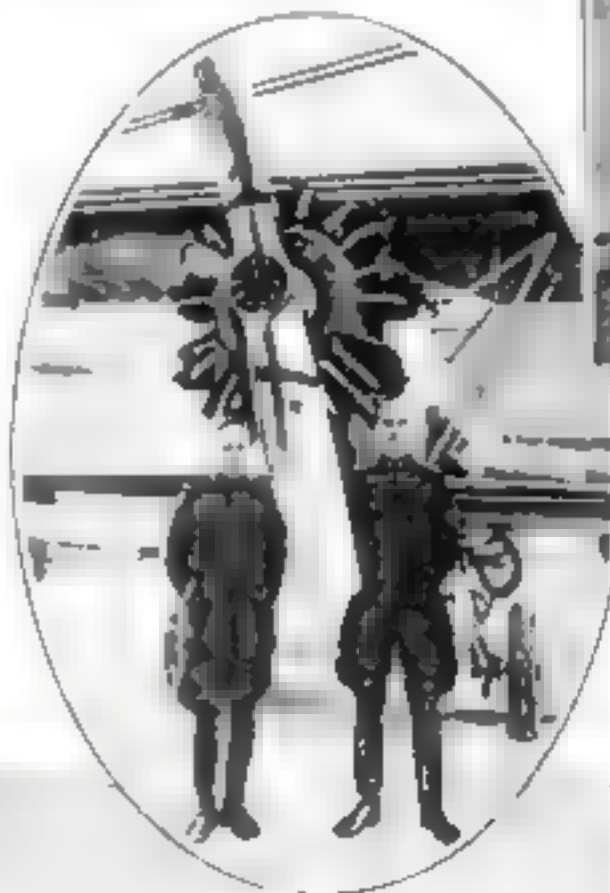
Early this year the *Italia* had been prepared for what was to have been the crowning achievement in scientific exploration of the Polar regions. As navigator of the *Norge* on its historic flight across the Pole, Nobile had gained first-hand knowledge of Arctic weather and flying conditions. His semirigid airship, the *Italia*, a sister ship of the *Norge*, had been designed and equipped especially to make scientific observations. At the North Pole he was to plant the flag of Italy, and set a cross given him by the Pope in Rome.

TO ASSURE success, Kings Bay, Spitzbergen, had been splendidly equipped as an airship harbor, and the steamer *Citta di Milano* had been sent there to serve as a mother ship, supply base, weather observatory, and radio station.

Nobile set out with supreme confidence. "In Polar exploration," he said, "experts who know how to travel on the ice are no longer needed, and men who know how to navigate the air take their place." He was to learn by bitter experience

that, with all the progress in aerial navigation, man still has not subdued the Arctic desert of ice and snow.

From the outset mishaps and delays upset Nobile's carefully laid plans. It was not until April 13 that the *Italia* sailed from Milan. Over Europe a terrific hail storm tore her propellers and damaged



General Nobile in the doorway of the *Italia*'s gondola greeting the throng at Stolp, Germany, after the airship rode through a heavy European storm.

the ship. Other Arctic explorers feared that the advancing season with fog and breaking ice would make conditions hazardous, but Nobile would not turn back.

The *Italia* set out from Kings Bay on May 11 on a sort of trial flight but had sailed for only seven hours when a blinding snowstorm drove her back to her hangar. Here, for three days, her crew battled a raging blizzard, barely saving the ship. The supply ship, locked in the ice, had to be freed with dynamite.

AT LAST, on May 15, the *Italia*, shining silver in the sun, set out to explore the uncharted ice pack as far as the half-mythical Lemn Land, more than a thousand miles away. The eastern coast of this bleak island had been discovered north of Siberia in 1913 by Russian ice breakers, but the western coast never had been seen. Hour after hour the *Italia*'s motors roared through the northern stillness, while radio messages told the world of her progress. As she neared her goal, freezing fog coated the ship's envelope with ice and weighted her down. Head winds joined against her. The breaking ice coat, caught in the wind stream of the propellers, crashed against the understructure, threatening to pierce the bag. The *Italia* turned about and on May 18 was back in her. (Continued on page 122)



Major Maddalena, refueling near Amsterdam, standing on the aeroplane from which he dropped provisions to the Nobile party. Above: Captain Lundborg (right), aviator who rescued General Nobile.

Huge Buildings Burned to Learn Secrets of Fire

Firemen Idly Watch While
Walls Topple and Effects
Of the Flames Are Recorded

By H. C. DAVIS

TWO brick business buildings in the heart of Washington, D. C., one of them five stories high, were deliberately set on fire recently. While most of the city slept, and more than 150 firemen with high-powered apparatus stood idly by, flames shot skyward, walls toppled and crashed amid showers of sparks.

It was one of the most spectacular scientific experiments ever attempted. From a safe vantage point in a dugout "observatory" near by, engineers with sensitive heat-recording instruments read the story of the fire's progress from moment to moment. They saw the flames spread with amazing rapidity until they melted iron. They saw floors burn away and plunge metal safes and cabinets into the furnace below. In less than an hour they saw both buildings reduced to a tangled mass of red-hot ruins.

The purpose of the experiment, directed by Simon H. Ingberg, chief of the Fire Resistance Section of the Bureau of Standards, was twofold: first to measure the intensity and duration of unretarded fire in buildings, second to test the fire-resisting qualities of standard types of safes and metal filing cabinets now in general use.

The buildings were abandoned structures which were to have been simply demolished to make room for new Government buildings. They stood near the National Museum less than a mile from the White House. Both were typical of a fairly old type of construction still common in American cities.

At fifty different points within the buildings were placed thermocouples, which registered electrically the heat produced at each point. Forty-five more were placed so as to be buried in the debris. All were connected by wires with



Ruins of the experimental fire, showing safes containing thermometers and clocks that were given to the flames.



Several days after the fire, which gained a temperature of 3,500 degrees F., the safes became cool enough to be opened. This one kept its contents intact from the ravages of the fire.



Two buildings were burned to learn of fire. White House fire was safer and less severe being burned to study modern fireproofing.

recording instruments in the nearby dugout.

Not only the lines of steel and iron, but the safes were restricted. The fire was kept at a temperature of 3,500 degrees, or above the melting point of iron. Thermocouples during the fire and clocks designed to stop when heavily jarrred, thus recording the time at which each safe fell through the burned floor. Waste lumber was placed in the buildings to simulate wooden furnishings.

FIRE companies stood ready to prevent possible spread of the fire to other buildings and police to prevent possible injury to spectators.

Just at dawn Ingberg applied the torch to a pile of oil-soaked kindling in the larger building and within fifteen minutes the whole place was a seething furnace. In the first few minutes, some of the thermocouples melted and stopped working at a temperature of 2,800 degrees F. In a few places the heat ran as high as 3,500 degrees, or above the melting point of iron.

Forty-eight hours after the fire apparently had burned out, and after two heavy thundershowers, thermocouples in the debris still registered as high as 1,000 degrees. And several days later the safes were still too hot to be opened or removed.

New Jobs for Old Metals



Like an employment agent for industry, the chemist considers the elements and weighs their qualifications, putting them to work where they are most needed and most useful in the world's work.

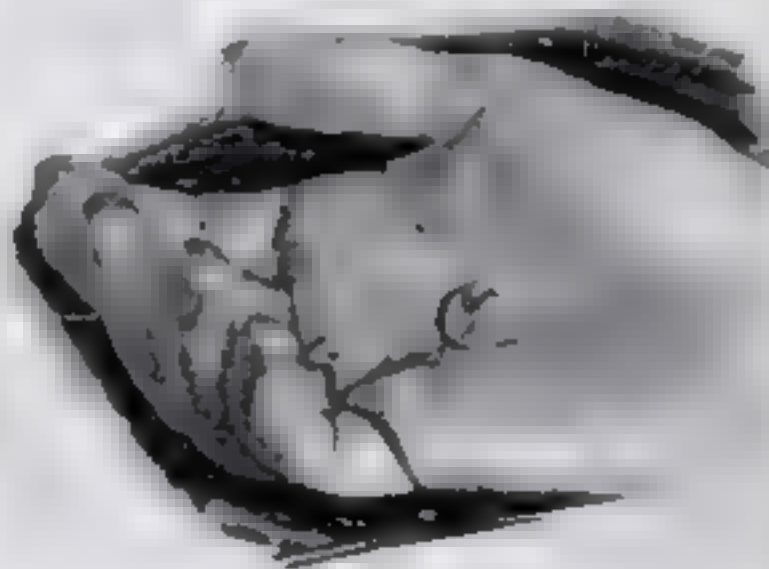
Seventy-nine of the Ninety Known Chemical Elements Are Idle, and Industry Offers Riches to Whoever Can Put Them to Work

By E. E. FREE

A COUNTRY where eight tenths of the workers were always looking for jobs would probably not be prosperous. Yet that is precisely the situation of the great modern empire of chemistry to which the world already owes so much.

There are ninety known elements—the workmen upon whom the chemist must depend for everything he does. Only eleven have found jobs really suited to their powers. The other seventy-nine are still sitting around on benches in the chemical employment office, waiting for jobs, or else they are industrial misfits—not quite suited by character or abilities to the work that industry has forced on them.

Iron, useful as it is, is one of these misfits. Paint is its badge of failure. Many of its present jobs require it to stand out in the weather. That is something iron cannot endure. The



A BIRD that stops to sip water from the ocean is making as much use of that ocean as man is of the vast possibilities that lie in the chemical elements.

In this article, Dr. Free, widely known chemist, points out that seventy-nine of the ninety known elements in the world have never been given a real job. Fewer do the work while the rest hunt employment. Fortunes await those who can find big jobs for them. This article will set you wondering and thinking.

Three hundred dollars worth of iridium, the costliest useful metal, used in jewelry, fountain pen nibs, and false teeth.

rust bill of the world has been estimated at five billion dollars a year. It is rust and not use that wears out railway rails and runs farm machinery. It is to resist rust that we pay a large part of the world's enormous bill for paint and painters.

Iron would have only inside jobs, safe from rusting weather, if chemists could only persuade some other elemental workmen to take over its outside tasks.

This is really the chief business of the modern chemist. On his desk lie scientific reports like letters from job-seeking elements. On that same desk are other imploring letters from elements that are overworked, like tin, lead, and mercury, elements desperately in need of help if the work of the world is to be well done.

Precisely as ordinary employment agents try to fit their human job-hunters to their open jobs, so the chemist tries to place each of his idle



Photo, N. Y. Electrical Society

Dr. E. R. Barry, General Electric Company, who helped develop fused quartz for ultra-violet glass, holding a fused quartz tuning fork, which keeps pitch at any temperature. Right: A thermometer of gallium in quartz tube that records temperature of 1,000° C.

elements in some work that it can do and do well.

This business of finding new jobs for chemical elements is extremely profitable, not only to the world but to the employment agent. Many fortunes have thus been made by chemists in the last fifty years and more are being made now.

One element has sat idle since its discovery—for 130 years—able to work as iron and perhaps as plentiful. This is titanium. Its idleness is not easy to understand. Titanium is a tough, hard metal grayish in color, reasonably workable and reasonably rustless. It can be used to make tools and implements. It might even support buildings, as iron now does.

THERE are vast deposits of titanium ores in a dozen countries. It is true the metal is not too easy to refine and there are no known alloys of it as useful as the alloy of iron that we call steel. But iron too, was hard to put to work when it was new. It needed centuries of effort by smiths and chemists to perfect the modern uses and varieties of steel.

Two elements whose history suggests the industrial "floater," getting job after job, only to lose them, are sulphur and iodine. Sulphur once was needed to make gunpowder, but smokeless powders were invented, giving that job to the element nitrogen, which they contain. Then the

doctors hired sulphur to do odd jobs of cleaning up the germs after epidemics, but improved fungating materials came along and sulphur lost another job.

Meanwhile a new process of extracting sulphur cheaply from buried deposits in Louisiana and Texas was perfected and the world's supply, previously obtained chiefly from volcanoes, was increased until there is now much more than anybody can use. The chemical employment agents are hunting things for sulphur to do on a large scale, and with some promise of success, especially for fertilizers and other agriculture uses. But at this moment, though it has several minor side lines, sulphur is still looking around for a full-time job.

From one of its best jobs iodine was fired only recently. A few years ago tincture of iodine was the badge of carefulness on every cut finger and scratched knee in the land. Now new chemical workers do this job more effectively, and iodine exists in quantities enormously greater than can now be used. It is a by-product in the manufacture of Chile saltpeter in South America.

SILICON is actually the second most plentiful element in the accessible part of the earth, surpassed only by oxygen. Yet it has no job, perhaps because it has sent only its picture and de-

scription to the chemical employment office. Even among chemists few have seen the hard, dark-colored crystals of silicon. In the form of one of its chemical compounds with oxygen, silicon is everywhere. It forms the mineral called quartz, and all the sandstones and sea-beach sands of the world are made of it. Recently chemists who have tamed high temperatures in the electric furnace have persuaded silicon to let itself be separated from its compounds more easily and cheaply. Soon it may visit the chemical employment offices more frequently. Then, probably, someone will spot it for a big job somewhere.

LIKE too many human workers whose own faults prevent their holding good jobs, there is a chemical element so violent and temperamental that few care to have it around. This is fluorine, which bites everything that comes near it. One compound of fluorine is that eroding ink that is used for writing on glass. Another compound is used to etch the insides of the frosted electric lamp globes to make them white, for fluorine dissolves glass and comes about as close as anything known to being that long-sought "universal solvent." Fluorine gets a few jobs, but in the main the vast deposits of its ore lie unused and the corrosive compounds of the element, held in wax bottles which they cannot dissolve, sit around unsought on the chemist's shelves.

Little-known metals like manganese and molybdenum are tried out once in a while on some special task—molybdenum has been used to make the inside parts of some radio vacuum tubes—but never manage to make good in a big way. Four metals of this class are newcomers, for only recently have chemists succeeded in making them in easily available form. These are thorium, uranium, vanadium, and zirconium. The first two, recently produced by Dr. Harvey C. Rentschler and his associates of the Westinghouse Lamp Works in their remarkable vacuum furnace heated by powerful radio waves, are slightly radioactive, sharing in some degree the marvelous powers of radium.

Then there is the family group of the lightweight metals, magnesium, lithium, and beryllium. *(Continued on page 1-3)*

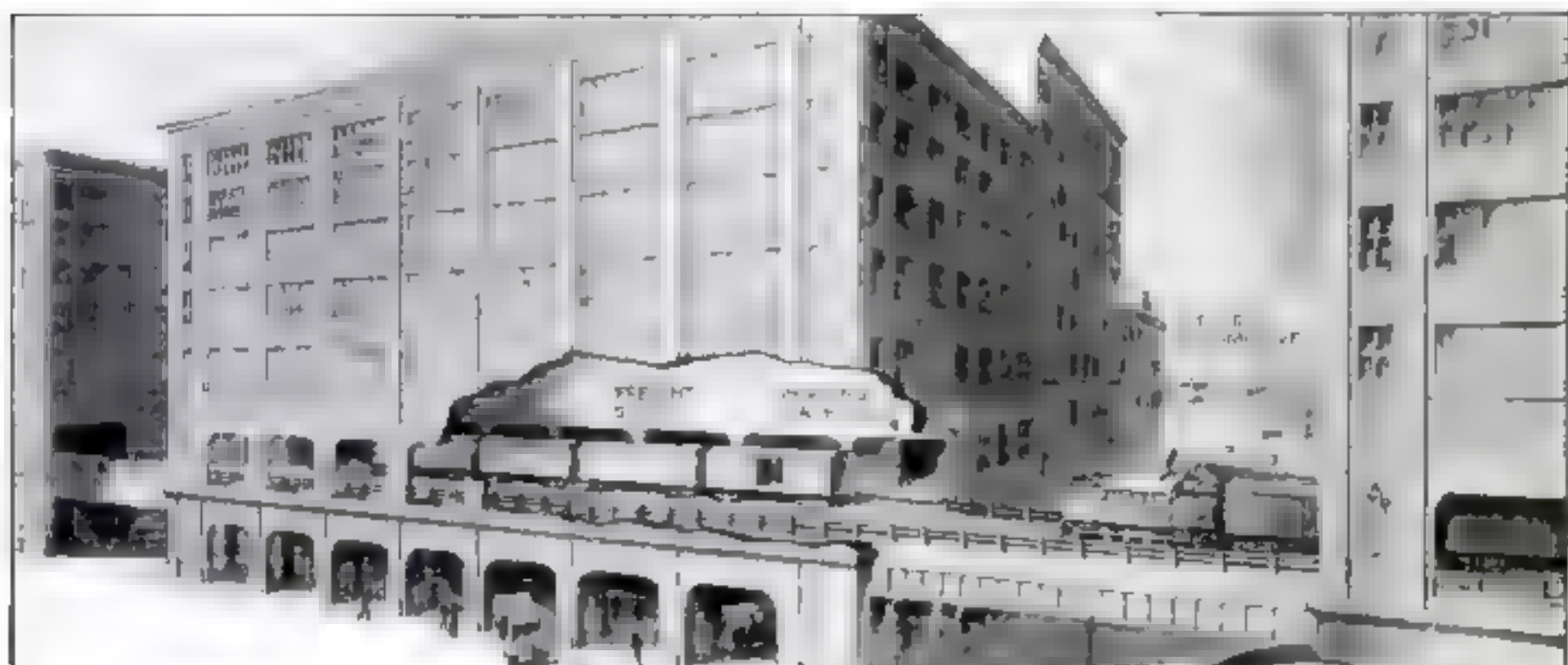


Neon, unemployed for 70 years now has a job to become in guide aircraft.



Thirty articles representing new uses chemists have found for sulphur. They include an automobile gear shift knob, radio horn, shampoo, cement, table top, and floor lamp base.

A Railroad on Cushions



How freight trains hauled by electric locomotives are planned to run free through openings in buildings on the highest elevated railroad tracks without disturbing the occupants with noise and soot.

Soundproof Freight Trains to Run Through Holes in City Skyscrapers

By JOHN WALKER HARRINGTON

NEW YORK CITY is to move a railroad out of its streets. It is going to rip up the freight tracks of the New York Central Railroad that now run along Eleventh Avenue, known as "Death Avenue," and turn them into an elevated line. Straight through the block between Tenth and Eleventh Avenues the new railroad will run, burrowing through skyscrapers, hotels and great apartment houses. Yet the occupants of those buildings will never know, by any sound, that a freight train is passing just beyond their walls.

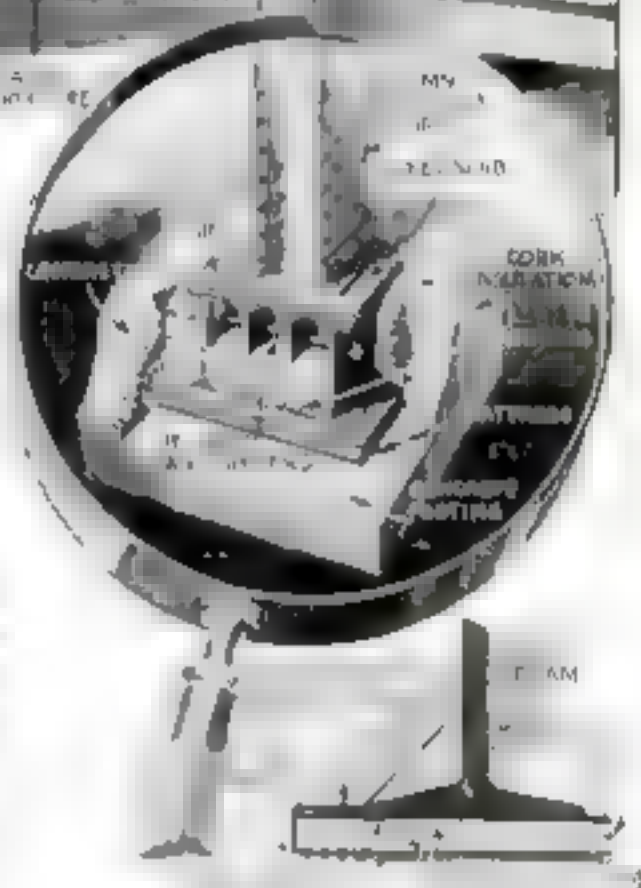
Vibration, the engineering name for the nerve-rasping screeches and shocks that ordinarily pulse through steel columns and beams, is the greatest problem that technical skill has met and conquered—but not the only one. The trains must be silent. They must be sootless. Over cross streets they must run on specially-designed bridges. It will be years before the railroad can be moved completely to its new route; yet today the general plan has been worked out by a committee of engineers of the state and city, the New York Port Authority, and the railroad.

Primarily it was adopted to remove the menace of chugging locomotives from the street traffic of "Death Avenue," and city, state, and railroad will jointly share the cost of eliminating grade crossings. But the rail-

road plans to go further and spend more than a hundred million dollars to establish a private right-of-way through the city. It expects to get back this money in revenue from offices, factories and apartment houses in buildings erected directly over the tracks.

SUCH freight trains running through veritable holes in these buildings may not jar their elevated tracks will rest on supports separate and independent from building supports. As a further precaution, each column that bears the elevated weight will have a springy, rubberlike foundation to absorb shocks. Rubber itself could not be used because it would flatten out under great weight but a substitute has been found in an inch-and-a-half-thick mat consisting of a core of sheet steel with layers of asbestos and sheet lead on each side.

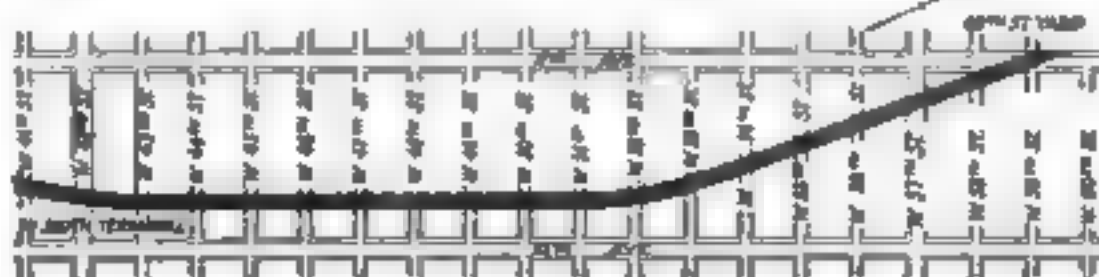
Even switches and sidings are to be laid in the interior of buildings, to serve factories or industrial structures along the railway line. These tracks, too, will rest upon separate columns carefully



The design of the shock-absorbing foundation upon which each elevated pillar will rest is shown in the broken-away view above. Between the column and its concrete footing is a cushioning mattress, as shown in lower diagram.

placed so that they cannot communicate their vibrations to the skeleton of the building. Air spaces, cork mats, and webbing in the concrete bases will help absorb jars. Such hum- and buzz-proof underpinnings have already been tried out successfully elsewhere in New York, where hotels and office buildings span present railroad tracks near the Grand Central Terminal.

Electric locomotives will help minimize noise and soot. Experiments in Berlin have shown it possible to build a nearly noiseless elevated railroad. Taking a lesson from these tests, engineers plan to use concrete and ashes on the roadbed of the new structure to deaden the sound of trains.



Route of the projected elevated railroad line to replace Eleventh Avenue tracks. Notice how it will cut through entire blocks of buildings and bridge the cross streets.

Jerry Smashes Through

By

JESSE F. GELDERS

Illustrated by Hanson Booth

ONE day in August, sixty-nine years ago, a well-driller named Drake saw his tools drop into a crevice sixty-nine feet down and strike oil. The black liquid flowing that day at Oil Creek, Pennsylvania, has grown into a Niagara of industry. Drake's well gave up twenty-five barrels a day. Now the world's yearly petroleum production runs close to a billion barrels. Last year American motors consumed nearly ten billion gallons of gasoline alone.

This story is a romance of oil, industry's fascinating adventure in which fortunes are made and lost.

"Abandon the well? After drilling four thousand feet?"

What is there to do, when three tons of steel tools are jammed at the bottom of the hole and you can't recover them?"

"Scrap them. Blast them to one side, or push 'em over!"

"No! That's not practical!"

Purdy Vincent Bolton, the vice president, stood opposite khaki breeches and shining, well-worn shoes, obviously convinced in his own mind. But Jerry Crandall, the young fellow who had been driller, was insistent.

"It's been done before," he asserted.

Jerry was leaning back in his chair, idly holding to the open front of his corduroy vest, but training his steady gray eyes appraisingly upon the vice president.

It was pretty hard to figure just how much Bolton really knew about the oil business. One did not want to judge him unfairly. His manner was so genial, and his smile so ready, that they almost made up for his pompous speech and his movie attire, chosen as if for rough, dirty work—yet never dirtied. He was ordinarily so tartful that you could almost forget the poor taste of the sign on the broad front window of the office he had established. Gilt letters as large as the ones in "Drumwell National Oil Company" announced: "Purdy Vincent Bolton, Vice President and General Manager." It was just a little precaution lest anybody underestimate him.

"WE APPRECIATE your suggestion," he said to Jerry, in his rich, strong voice, "but it's not practical."

"Don't you think we at least ought to consider it, Mr. Bolton?" urged a little man with a salt-and-pepper moustache, who had come from the East to represent some of the stockholders. He was badly worried and eager to grasp at anything, for there was not enough money to put down another well.

"You know," he continued, "we've already spent upwards of a hundred thousand. The stockholders are not wealthy men.

A black column shot up, thundering like a suddenly freed Niagara. With a crash, the steel tools tore through the derrick timbers. Jerry did a jig and flung his hat madly into the air.

ASTILLNESS hung about the rig of the Drumwell National Oil Company. From Main and Broadway, you could just see the faint outline of the derrick, tapering above the scrub oaks on the hill, far to the north of town.

In the other direction, and closer, a bristling forest of rigs marked the rich oil pool which had brought Drumwell into existence and fame. Oh, that was a pool! Even now, trucks were rumbling along Broadway with supplies for new drilling, timber, engine parts, casing, pipe fittings. In the dark of morning, when the countryside was nearest to quiet, you could hear the engines pumping oil from the older wells with irregular, resonant chugs, like giants coughing.

There had been half a dozen attempts to find oil under the hill to the north, too, but all had ended with dry holes. The failure which seemed to have overtaken the Drumwell National's venture, however, was of another sort. It was premature. The cable had broken and the tools had fallen into the uncompleted well.

In the company's office, a small storeroom in a frame building on Main street, Buck Norden had just told of six weeks' vain efforts to fish out the tools. Discussion of plans for the future was approaching a row.

"They're just small-town merchants and farmers, most of them."

"Yes, yes, Mr. Galt." The vice president crinkled his florid brow and lowered his voice to a sympathetic softness. "Then there doesn't seem to be any practical course but to liquidate and sell the lease for whatever a purchaser will pay."

"All the money we've spent for drilling would be lost?"

Bolton nodded sorrowfully. "There doesn't seem to be any other practical alternative, Mr. Galt."

Now, at Galt's request, he took up Jerry's proposal with forced patience.

"**Y**OUTHFUL enthusiasm," he admitted, "is a fine thing. But often it isn't practical. Now—but wait. It would be cheaper to go on fishing for the tools awhile longer. Do you think—?"

He turned questioningly to Buck Norden.

"I might be able to get them out," Norden replied with an expressionless stare.

"But you said before that you couldn't," Jerry challenged.

"They're wedged in pretty tight," Norden admitted, still with a blank gaze.

"Then let me go ahead and subtrack them," Jerry demanded.

"Now see here," said Bolton, turning directly to Galt, "that would be a large amount of additional expense. Mr. Crandall is an extremely competent young man, and I would like to please this whim of his. But it really doesn't look as if we would get oil there anyway. It's a wildcat well, an experiment in unproven territory. There have been six dry holes on that hill."

"But, Mr. Bolton, everybody knew that before we started," Jerry argued. "I knew it, and still I took part of my wages in stock in the company, didn't I? The idea was that none of the others had gone deep enough."

We were going six thousand feet if necessary. You know we didn't expect oil at four thousand."

"Yes, young man, that is true, but—"

"Well, I'd hate to see this well abandoned now. I'd be willing to go East myself and talk to every one of the stockholders. This well can be saved. I can show them where it's been done before!"

"Young man— Bolton was about to reply impatiently, but controlled himself. "Of course," he said, smoothly, "if I thought it could really be done—"

GALT spoke. "Let's give it a try, Mr. Bolton. We've gone so far already."

"Mmm." The vice president hesitated. "Very well then. Fair enough."

When the details had been arranged, and Jerry was leaving, Bolton slapped a soft, thick hand upon his shoulder.

"Youthful enthusiasm is a great thing," he said heartily.

"A great thing. I like to see a young man with determination. But—but—I only hope this doesn't prove to be an expensive and unwise mistake."

On the Drumwell National's lease, the boiler made eager noises over its new fire. Jerry went about his preparations on the derrick floor with grim energy. He had sent Phil Medford, the tool dresser, up to oil the pulleys on the crown-block, some ninety feet overhead. His face was set, and there was a little anxious furrow between his gray eyes.

It was a hard job and a

doubtful one that he had undertaken. He had spoken confidently of getting past an obstruction—wreckage, practically—that lay more than three quarters of a mile beneath the ground. Before he could cope with it, he must know the position of those unseen tools.

He tested the softness of a huge chunk of wax on the impression block which was to carry his sense of touch, almost his sight, to the bottom of the hole, and return stamped with the record of what lay there. As the tool dresser came down the ladder, Jerry was ready with the block attached at the lower end of the hauler—the man-high bucket which would weight and steady it. He swung it out over the mouth of the well and let it descend. The sand line to which it was attached ran swiftly, playing back and forth across the ten-inch diameter of the hole as the hauler and block dropped toward the bottom.

The story written in dents on that chunk of wax, as he brought it up after repeated tests, deepened the lines between Jerry's eyes. The tools, thirty feet long and of solid steel, lay with the top wedged inaccessibly against one side of the hole and the bit jammed into the other side.

FOR a little while Jerry wondered if Bolton had not been right after all—if the chances of finding oil in this wildcat well really were worth the effort of saving it. He sat down on the bench against the wall and pulled his worn notebook from his pocket. He studied the list he had made there of the different rocks and sands they had passed through, and compared it critically with the record of the upper formations in the rich pool to the south of Drumwell.

The comparison gave him heart. At the surface they first had gone through the same bed of red clay to a depth of about fifty



"We'll go a little deeper—about a screw," said Jerry. "We'll see how it looks then." Before they had gone half of the five feet, a run of the hauler showed a foot of blackish oil topping the column of water.



What does it matter who I'm with?" Ellen demanded. "I want to buy the lease I'm talking cash."

feet, and below that through corresponding layers of limestone, blue shale, sandy shale, sandy limestone, and so on. Reaching a depth of 1,570 feet, the bailer had brought up the same curious gummy blue shale—so sticky that it clung to the fingers and stretched out almost like taffy. Yes, if the story of the rocks meant anything—and to Jerry it did—then there was a chance, and a fair one.

When Medford came out of the engine house, where he had been working, Jerry stood up.

"That's all for today," he announced. "We'll get Curtis here tomorrow."

CURTIS was the best oil well "shooter" in the field. He drove up to the rig in his mud-spattered car, glaringly lettered "Danger—Explosives" and looking like a combination plumber's and telephone lineman's truck.

Jerry gave him the details of the well and said "Go ahead. Give her a good shot."

He looked on calmly while Curtis poured nitroglycerin into the long, slim metal shell and then lowered it into the well. Anxiously he watched Curtis tugging gently, inquiringly, on the line which supported the shell. Jerry's air was almost casual as he tried it himself, but when he nudged and stood back for Curtis, his knuckles showed white.

This was a delicate job. With only the measurement of the depth and the feel of the weight to guide them, they had to make sure that the explosive had reached the right position, alongside the tools at the bottom of the hole. Satisfied at last, the shooter dropped a squib—a smaller shell with a lighted time-fuse to detonate the first—and waited.

Jerry's face was worried, but eager now. His gray eyes glinted with the light of battle. If he could charge past that steel barrier, his argument with Bolton would be vindicated.

"There she goes," Curtis announced suddenly.

Unheard, unless except by the shooter's trained senses, the bombardment had occurred. Somewhere underground, the nitroglycerin had loosed its smashing, tearing power. Whether it had taken effect upon the tools remained to be seen.

The faint acrid gas of the explosion had barely found its way to the open, and the shooter's car was scarcely out of sight, when the impression block was dropping into the hole again. Jerry worked anxiously. The sand line unwound and wound again on the spinning calf-wheel.

IT WAS dusk when the tests were concluded. Jerry smiled, but with gritted teeth, at the picture brought up by the wax block. Success was only partial. The blast had driven the tools to one side. The upper portion was clear, but the bit at the lower end still lay in the path of drilling.

"Well?" Medford queried.

"We'll start tomorrow," replied Jerry.

"Another shot, you mean?"

"No. Drilling."

"Through that there bit?" the tool dresser demanded incredulously.

"By it."

There was steel in Jerry's voice.

"By it?" Medford grinned appreciatively. "Can't nothing stop you, can there?"

The two men started toward town together in Jerry's battered roadster. A short distance from the well Jerry halted the car abruptly and slapped his hand on the wheel.

"I wanted to stop those leaks in the boiler line," he declared, "so we wouldn't be delayed tomorrow."

"How long'll it take? I'll go back with you."

"No. I may be a couple of hours." He looked down the road at the long distance Medford would have to travel to town. It was only a short walk back to the well. "You take the car," he said. "I may just roll up in that old bedding in the engine house and spend the night there."

"I'll drive back for you, later on."

"Never mind. You get some sleep, too."

Full darkness had come when Jerry completed his task. He rolled himself into the blankets. A soft wind, tainted by gas from the field to the south, brought the faint, hulling echoes of the engines pumping oil—and wealth.

IT WAS a moonless night. Most of the distant lights of Drumwell had been extinguished, when Jerry started up from his sleep. There was an auto on the road below the rig. Its silhouette was almost lost in the blackness of the hillside.

"Hello!" Jerry called sleepily. "Medford?"

No one replied.

There were brief, muffled voices, and the shadows near the car revealed the forms of two men who, apparently surprised at finding Jerry at the rig, hastily climbed back into the auto. The door slammed, the motor rared, gears sang out, and the car was gone.

Jerry peered after it. It had not carried Medford. The shadowed outline had been that of a closed model, not a roadster.

The identity and the mission of the prowlers had been hidden by the darkness, but thereafter the rig was never to be left unguarded.

* * * *

The fresh string of tools gleamed in the sun as they started into the well. Thirty-odd feet of smooth, gray steel, eight inches through, they gave off a heavy, solid *clink* as they scraped the side and slipped swiftly out of sight. The huge spool-like bull-wheel whirled as the steel cable sped from it up to the pulleys in the crown block and down into the darkness of the well.

Four thousand feet of line spun out, and the tools were at the bottom. Then the walking-beam was moving, like a giant seesaw, with its heavy arm made fast to the cable above the well. Jerry watched it lifting and dropping the line, its rise and fall marking time while the three tons of tools beat their smashing rhythm, unheard, in the earth below.

HE GRASPED the cable, getting the feel of the distant impact. This was not an ordinary drilling job. His tools down there were pounding upon another bit, as hard as they, virtually impenetrable. Progress could be made only as the obstruction was shoved to the side, or as the blows glanced off and dug their way angularly by it.

It was tedious work. The rise and fall of the walking-beam counted off hours. Then days. Finally weeks.

Jerry stood, meditatively tapping a folded letter in the palm of his hand.

"Punny thing," he observed to Medford. "Friend of mine back East says some fellow has been" (Continued on page 146)



A scientific use of photography that is as valuable as it is unusual. The camera is employed to determine the exact percentage of ultra-violet light (which is invisible to the human eye) that passes through a specimen of special glass manufactured for use in experiments.

New Magic Worked by Cameras

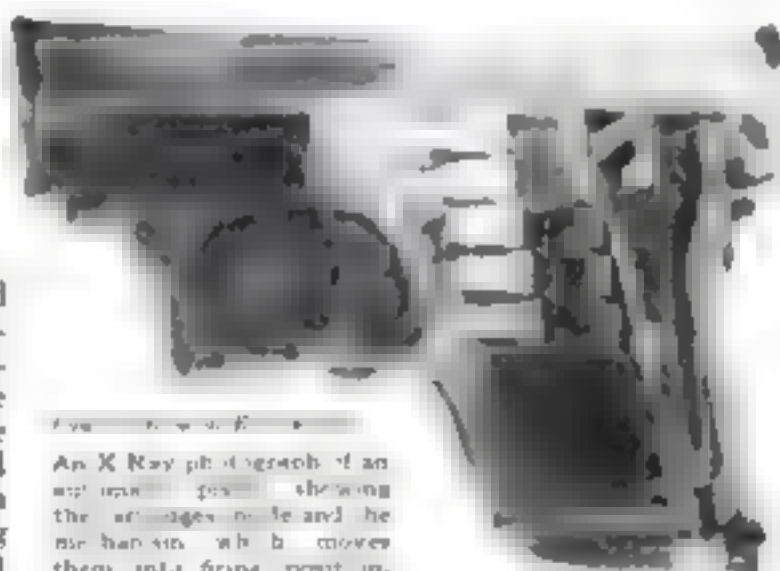
Amazing Modern Photography Solves Problems of Science, Industry, and Athletics, and Even Settles Legal Disputes

By ELLSWORTH BENNETT

IN A California court the other day Capt. W. B. Sellner, State Fish and Game Commissioner, accused a man of trespassing and dumping garbage on his property. Vigorously the other protested his innocence. The court was puzzled.

"One moment, Your Honor," said Capt. Sellner. "I can show you first-hand evidence." With the court's permission he tacked a bedspread on the wall and produced a roll of film made with a home movie camera. A second later, judge and culprit saw a movie of a man caught in the very act of dumping garbage—blissfully unconscious that an all-seeing camera was focused upon him, recording every movement. "Guilty," said the judge.

Many the lawsuit that has been decided, as in the case above, by a photograph, such is the reputation of the modern camera as an eye that sees every detail and does not forget. But today's camera can do more than that. Science and industry alike know it as an ally. It can photograph things that no human eye can ever see. It can picture lightning, study the explosion of blasting powder, slow up for human eyes the crash of an airplane into a concrete wall. So fast are cameras that they can capture an event that is over long before you realized it was going to happen. So sharp is the camera's eye that it can peer through solid metal



An X Ray photograph of an exploded gun, showing the arrangement of the fragments and the line of fire.

THE MAGIC EYE

IN 1839 there was only one camera in the world. The story that begins with Daguerre, a scene-painter for the Paris Opera, and his "tintypes," and ends with the wonders of modern photography, is related in this dramatic article.

An image flashes upon the eye and vanishes. It flashes upon a film and remains forever. How such films have helped us study the stars, discover unsuspected things about the lightning, even led to the discovery of an entirely new chemical element, is related here. Everyone who owns a camera or has taken pictures will be interested.

Today anyone can buy a camera that will take a photograph in the incredibly brief time of a thousandth of a second and "freeze" into stark immobility racing automobiles and leaping athletes. Specially built cameras perform wonders greater than these, and catch the jagged, twisting forks of a streak of lightning—the speeding flight of a rifle bullet—or the flying droplets of a splash of water stopped in mid-air.

ALL these are things that science would like to know more about, and is studying with the aid of the camera. No bolt of lightning is fast enough to escape the swift camera that J. W. Legg, research engineer of the Westinghouse Electric and Manufacturing Company, designed and built. A gleaming, polished metal mechanism studded with twenty-two glass lenses, this instrument has no counterpart in the world. Its two revolving shutters take 2,000 pictures of electric flashes in the laboratory each second. When Legg trained his camera on huge sparks, he found for the first time that artificial lightning—and natural lightning, too, it may safely be assumed, for both are simply great electric sparks—actually travels, not in zigzag or in straight lines, but in spirals. He had caught real moving pictures of the corkscrew-twisting sparks; and had demonstrated the

value of his instrument for studying the behavior of high-voltage currents, important in power transmission.

Just as these sparks furnished their own light to the photographer, electric flashes replace inadequate daylight or ordinary electric light for super-speed pictures.

Extraordinarily ingenious arrange-

if shod with rubber. American trainers were among the first to use such films to find out what was wrong when promising young athletes failed to show expected excellence. And in hurdling, for example, the camera has revealed how the American Simpson, and later the Canadian, Earl Thompson, were able to achieve "impossible" new marks that finally brought a fifteen-second record for ten hurdles in 120 yards down to $14\frac{1}{4}$ seconds. Both men had a trick of raising the knee of their trailing leg to shoulder height to clear the bar, so speedy as to pass unnoticed to visual observers, and probably not even fully appreciated by themselves.

New secrets of the birds' flight, one of the longest standing mysteries of science, may give way at last to the latest wonder

armor-piercing shells into hardened steel targets. Imagine the consternation had one shell gone astray and wrecked this priceless mechanism!

Not long ago, at McCook Field, Dayton, Ohio, a number of condemned airplanes were sent crashing at full speed against a concrete wall to determine just where fire breaks out in a plane's motor after a crash, so that improved engine design would decrease the hazard. Ultra-rapid movie cameras photographed the planes being wrecked; and films made at eight times normal speed, developed and run over again slowly, revealed the source of fire danger.

THESE are examples of the pictures taken at terrific velocity that reveal, when slowed down, surprising facts about people and machines. Reversed, the process has equally fascinating possibilities. Pictures of things as slow as the growing of a plant have been taken on a continuous reel of film, each time from the same position, at intervals of, say, a day, and later shown as a continuous "movie" in which the whole action of months is condensed into a frac-



Photograph of a bullet flying 2,700 feet more than half a mile a second entering a soap bubble which is filled with a mixture of nitrogen and air

ments have been made so that speeding bullets break an electric wire in their flight and take their own "flashlight" picture by the resulting spark. And an English experimenter Worthington, took the first successful photograph of a splash of water in all its stages by suspending two metal balls by magnets so wired that a single electric switch would release both balls at once. The first, dropping into a tub of water, made the splash, the second, falling past the terminals of an electric condenser, released a spark that took the instantaneous picture. By altering the timing of the spark through changing the distance the second ball had to fall, he photographed at will the beginning, middle, and end of the splash.

How safe an explosive will prove for use in a mine is determined, now, by taking a speed photograph of its flame. The height of the flame from a measured charge of blasting gelatin or powder, impressed on a moving film that bears a graduated scale, shows just how soon after ignition the explosion reaches its height, and how far the flame has spread. A "permitted" or "safe" explosive gives a small flame and is completely burned in a tiny fraction of a second.

MOST of us have seen "slow movies," generally intended purely for amusement, that are produced when a film projected at standard rate has been taken much faster. Fast runners become models of slow, graceful action; an athlete seems to float over a hurdle, and a leaping horse soars gently over a barrier, to rebound as



P. P. Quayle of the Bureau of Standards, with the amazing camera with which he made the accompanying photographs of a flying bullet.

camera, brought to this country by the Japanese expert Baron Shiba. That is the use one noted engineer, Elmer A. Sperry of gyroscope and airplane beacon fame, sees in the camera that takes 20,000 pictures a second. Designed for research in aeronautical design, it is expected to disclose new facts about air streams from propellers and air currents around the wings of a plane. It makes a spinning propeller look like a slow-revolving door, and a bullet whizzing through air like an idly-drifting black chip.

WHAT happens inside a Diesel engine may now be studied through the use of a new photographic device that takes 4,000 pictures a second, each one in a millionth of a second's time, according to W. F. Joachim, head of engine research for the Advisory Committee of Aeronautics at Langley Field, Va. A camera designed to study the explosion and burning of fuel as it is sprayed into the motor's cylinders at high pressure is attached to the combustion chamber to take a picture through heavy plate glass; a high-tension electric spark provides light. Ten pictures have been taken, Joachim says, that show the complete spraying operation.

A ten-thousand-picture-a-second camera developed for the British Admiralty has shown the actual penetration of huge



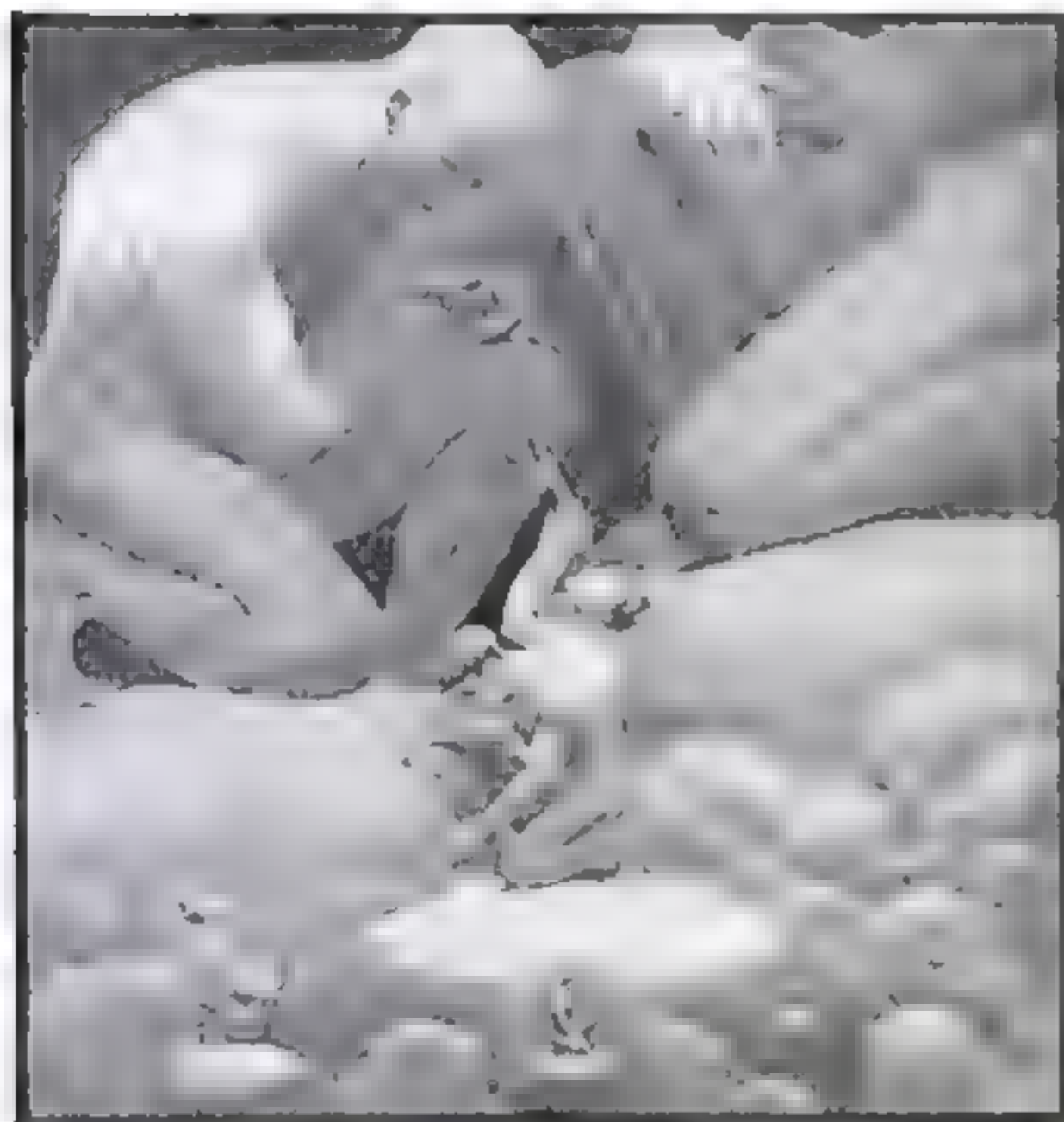
The .38 caliber bullet emerging from the bubble it is seen entering above to the left.

tion of a minute. Such pictures are a revelation of the way a plant really grows, they show its extraordinary contortions as, rooted to one spot, it writhes, twists, and unfolds.

Following the same plan, Prof. R. J. Terry and two assistants at Washington University recently attempted to prepare a "fast movie" of hair growing on a man's chin after a shave, photographing exactly the same spot of skin through a powerful microscope every two hours for four days. Though it failed as a "movie," because the subject's skin stretched and jerked the hairs about between the exposures, the picture made a valuable record of the speed of hair growth.

Nor are nature and anatomical studies the only ones where "fast movies" are of value; it is equally possible to photograph, step by step, the building of a bridge or a skyscraper, says (Continued on page 136)

Is Man Pygmy or Giant?



It all depends on the point of view—whether you look through the telescope or through the microscope. In this inspiring article a noted educator, a member of the faculty of the College of the City of New York, reveals how man, standing between two infinities—the large and the small—and mastering the laws of both, has risen above insignificance.

*He Has Made Himself
Master of the Earth,
Yet in the Universe
He is Merely a Speck*

By

WILLIAM BRADLEY OTIS

his cities, his skyscrapers, his factories and his railways.

In the vast stretches of such a universe, what a pygmy seems man!

ONE individual is lost to sight in a great city. And that city, on a map of the world, appears smaller than a speck of dust on the side of a circus elephant. And that world, in the universe, is like a drop of water compared with the wide Atlantic. And beyond that universe, for all we know, stretch super-universes in which the distance from earth to our farthest star will look like a sixteenth-inch mark on a surveyor's long steel tape!

An idea of the staggering size of the universe was given the other day by Prof. Edwin B. Frost, director of the Yerkes Observatory at Williams Bay, Wis. If you hold a dime at arm's length toward the Milky Way, he said, the coin will hide about fifteen million suns! A single photograph including less than one-thousandth part of the night sky revealed images of about 400,000 stars. The far-distant star Antares appears through telescopes as a tiny speck in the heavens, yet it is forty million times as big as our sun.

In the last thirty years, discoveries of astronomers have extended the boundaries of space ten thousand times.

Thus, looking up and out from his planet, man feels himself grow smaller and smaller. He sees written in capital letters the story of his own unimportance. In such a universe, what a pygmy he is!

BUT, looking in another direction, he reads another story. It is the most fantastic, incredible tale science ever verified. It tells him that he is a giant, a colossus, who walks on universes, who holds a million whirling suns and satellites in the hollow of his hand, who brushes a solar system into space and calls it a speck of dust!

It tells him that the very telescope with which he studies a universe so vast it makes him dizzy is made of little universes so small he cannot see them. The metal tube of his instrument, and the very glass through which he peers, is formed of solar systems whirling in ceaseless activity.

When you turn this page and feel the paper between your thumb and finger, you know that its thickness barely separates them. Yet for that short distance—about one-six-hundredth of an inch—300,000

(Continued on page 155)

SOME weeks ago astronomers announced that a star, Nova Pictoris, apparently had split in two. The spectacle, described recently in *POPULAR SCIENCE MONTHLY*, was offered as a remarkable new discovery. Yet the actual event had occurred sixty years before Christopher Columbus was born! It had taken all the time since for the fastest messenger known to man to bring us the news. The distance between the earth and this star is so great that it took five centuries for a ray of light, traveling at more than 186,000 miles a second, to bridge the gap.

When we stop to consider that for a moment, we begin to wonder about man and his place in such a vast universe. Is he a pygmy or is he a giant? To find out, let's first look at the universe around us.

Pick out the fastest thing you know. The hurricane? It goes a hundred miles an hour. The locomotive? It goes a hundred and twenty. The racing automobile? It goes two hundred and six. The airplane? It goes three hundred and fifty.

They are all too slow! Ride a beam of light. It travels so fast that it can circle the globe eight times while you draw a single breath.

Are you ready? Go! Speeding into

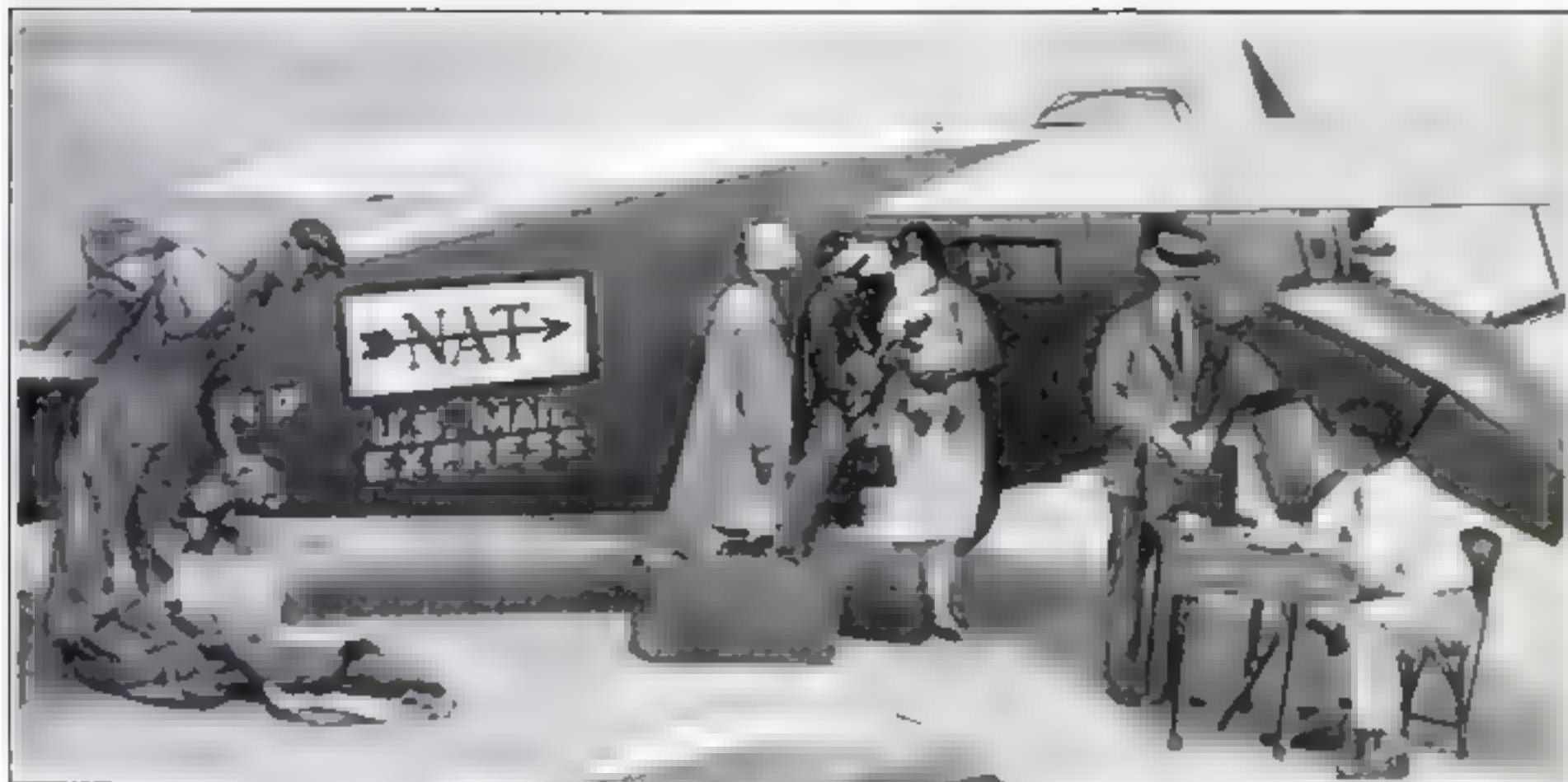
space at the rate of 186,000 miles a second it takes you three and a half years to reach the nearest star. It takes you twenty-two years to reach Sirius. It takes you more than seventy to reach Capella, and your journey is just begun!

You will travel for six hundred centuries before you come to a far star on the borderlands of the Milky Way, and for more than a thousand centuries before you reach the most distant star we know.

Long before the dawn of history, even before the coming of the first Neanderthal man, this last star may have disappeared from the sky. Yet we see it still! The light rays that we see tonight left it more than 100,000 years ago. The ones starting today will be seen on earth a thousand centuries hence, after thousands of generations have come and gone. What sort of people, living in what sort of a civilization, will see those rays? An interesting question.

IF LINDBERGH hopped off for Mars in his airplane and flew at top speed all the way, before he reached the planet he would be an old man of seventy and over!

The dot on this "i" looms immeasurably larger on this page than does our earth in the universe. And on this earth speck he the pride of man's handiwork—



Passengers boarding a National Air Transport plane at Kansas City for the 500 mile trip to Chicago in a Travel Air machine

Field manager right checking passengers on board in mail plane for a flight that will take them to Kansas City in 5 hours

Muddux Airlines, the fare is \$8.10. This is a passenger fare exclusively. With its recent extension to San Francisco, four lines now connect that city and Los Angeles.

The Midwest, too, has its air routes. Chicago is the hub of a whole series of radiating airlines. For instance, Northwest Airways, runs planes to Minneapolis in five hours, while the taking pride of the Northwestern Railway, takes eleven hours to make the same trip. You can breakfast in Chicago and lunch in Memphis, Tenn., via the new six-hour \$100 service of the Mid-South Airways.

What has the East to compare with these lines? Besides its part of the transcontinental route, it has the New York-Boston airway—and that is nearly all!

THE Colonial Western Airways connect Cleveland and Albany. The St. Tammany Gulf Airline, which flies the daylight part of the New York to New Orleans mail route, accepts passengers between Atlanta, Georgia, and New Orleans. Planes of the Pan American Airways fly between Key West, Fla., and Havana, connecting with the Havana Special train from New York.

That is the best the East can do today, but it is going to do better. Airlines are proposed between New York and Washington, and by the time this article is published one may be in operation between Washington and Norfolk, Va. The cross-country line to Chicago, now an "emergency" service, is to be vastly improved upon.

A new airport at Newark, N. J., will give New York half-hour connection with cross-country airlines. One of the first to use it will be the newly announced New York-Montreal air passenger service of the Canadian Colonial Airways.



Short air trips are as practical as long ones; and every important stopping point along a through airline has "feeders" or local connecting lines that serve it. Thus from Cleveland, on the transcontinental airway, you can go to Detroit in three and a half hours by the Stout Air Services, running two roomy cabin planes daily, and to Albany and Buffalo by way of the Colonial Western Airways. Chicago has connections to Cincinnati via the Embury Riddle Company's planes, to St. Louis via Robertson Aircraft; to Kansas City over the National Air Transport's route; and to Memphis

and Minneapolis by air lines already mentioned. At Cheyenne, Wyoming, the Western Air Express planes provide a trip to Pueblo, Colo., and the same company connects Los Angeles with the transcontinental line at Salt Lake City, Utah.

IN MANY states, too, short inter-city trips by air are or will be regularly scheduled. Thus Oklahoma, for instance, has a statewide passenger air service operated by the Oklahoma Air Transport Company and another Tulsa-Oklahoma City air line. Other states, notably Michigan and Texas, are blanketed with air lines.

Timetables of the Cleveland, Southwestern Railway and Light Company announce that the railroad's ticket agents will sell tickets on the Stout airline between Cleveland and Detroit, probably the first recorded instance of a railroad selling air tickets. In this case, the air field is near the Cleveland station. Generally airports are more remote; and some air transport companies provide buses or cars to transport passengers from the nearest railway station to the field.

Today's air lines are regularly scheduled services; hence the "air time-tables" we are able to present with this article. To some extent they are dependent upon the weather; many mail lines will not carry passengers if weather threatens, even though the pilot may go through with the mail. This is one of the best answers to the question, "Is air travel safe?"

In many places it is developing with almost painful slowness, so cautious are transport lines to make sure that it will be safe. And over all but the best-lighted airways, no air line will carry passengers at night, though the air mail goes through with practically unfailing regularity.

"Air taxi" service at any large
(Continued on page 124)

A ticket for a trip from New York to Chicago on a National Air Transport plane. The price is \$7.00. The upper third is the passenger's receipt and identification. Note map.

Is Oil Burning Too Costly?

More Comfortable and Convenient, Certainly, But This Article Weighs the Problem as It Affects Your Purse

By JOHN E. LODGE



IS THE added comfort and convenience of an oil burner worth the price? That question today confronts every prospective home owner. The

answer, of course, depends on the value you put on the advantages of oil heating, and other factors that must be considered in contrasting oil with other fuels.

The oil burner is, after all, only a highly perfected mechanism for producing heat. And, without an efficient heating plant to transfer that heat to the rooms in your house, the oil burner must work under a severe handicap.

Theoretically, a ton of coal equals in heat value from 100 to 215 gallons of oil. But it is one thing to determine the theoretical heat value of a fuel and quite another to find out how much heat is actually used. Your heating plant, not the fuel, determines that, whether you burn coal or oil.

Burning fuel produces heat in two ways, the hot gases and the radiant heat from the red-hot lumps of coal and the flame. A good boiler absorbs the largest possible amount of both kinds of heat. The rest is wasted up the chimney.

A boiler that gives good results with coal may not do as well with oil. The two fuels do not burn alike. Coal, most of the time, is burned with a reduced draft, whereas the mechanical draft oil burner always runs full blast.

An inefficient boiler, one with inadequate heating surface, may give fair results with coal because the coal is burned slowly, permitting the surface in the boiler to absorb a fair percentage of the heat. An oil burner under such a boiler will blow most of the heat up the chimney.

INVESTIGATIONS of the Popular Science Institute of Standards have shown that when oil heating costs too much, the trouble nearly always is due to an inefficient boiler. This means, in short, that if you have an inefficient boiler your coal bills may be higher than they should be, but if you install an oil burner you will be even more heavily penalized.

But you must not get the idea that the boiler installed in the average home is so poor that it won't work with an oil burner. That isn't so, because even if the boiler is below par it can be improved by adding sections to give more heating surface. And a good oil burner used in conjunction with a good boiler always produces more heat than would appear theoretically to be possible.



An ideal oil-heated boiler. Shutting off the main supply to radiators so that the plant may be used during the summer solely to provide hot water.

That is because during fall and spring and every warm spell the oil burner shuts down and uses no fuel. A coal fire, at such times, keeps right on burning coal.

Reports received by the Institute from oil burner owners prove these points. Here is one from a man in New Rochelle, New York, that shows what oil heating will do under a good boiler.

"In 1925 I spent \$204.75 for coal. In 1926 the bill was \$157.50. During both these winters I paid a furnace man \$15 a month to take care of my furnace or a total of \$120 a year. I began to burn oil March 1, 1927, and from that time

until June 15, 1928, I have used 2,832 gallons, which cost me \$240.81. Now when you stop to consider that this figure covers the cost of heating my home through an entire winter and, in addition, kept us supplied with all the hot water we could use for a year and a quarter, making it unnecessary to burn any gas for hot water heating, I think you will agree that I'm getting the luxury of oil heating at a pretty low figure."

The photograph shows this particular installation. A heating coil is connected to the hot water storage tank so that during the winter the water is heated as in any similar installation. When summer arrives the owner merely shuts off the main supply pipe to the radiators upstairs by means of the large valve. A switch is thrown to connect the oil burner control to a different thermostat so that it will run the main boiler only enough to supply hot water to the hot water storage tank.

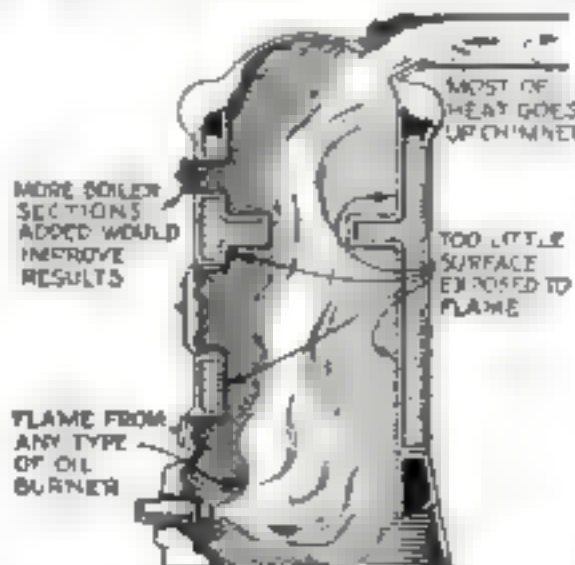
The excellent results described are obviously due to the modern, amply large and efficient boiler used.

HERE is a report from an oil burner owner in South Carver, Mass. "In the winter of 1926-1927 I burned about twelve tons of hard coal at \$17.75 a ton, a total of \$213.00. This winter, from October 15 until April 11, I used 1,020 gallons of oil, costing, at ten cents a gallon, \$102.00. Probably before summer my oil will have cost me about the same as the coal, but I have received much more and better heat. I keep an average temperature of seventy degrees to seventy-five degrees in my house all the time. With coal it was from sixty degrees to seventy-five degrees." And now comes a very significant statement, "The heating plant now requires no attention at all and I would not want to go back to coal again."

This particular owner has his oil burner installed under a boiler that is quite old, but it is of adequate size with plenty of heating surface. The high price of both the coal and oil he has used undoubtedly is due to his location.

And to show what happens when the boiler is inadequate note this report from a doctor who has a large house in St. Louis, Missouri.

"I find that I used for three years with the old boiler a little over 6,000 gallons of oil fuel a year. For the year just past I have used about 4,500 gallons and have had hot water automatically supplied throughout the summer, so you can see what can be accomplished by installing a really good boiler."



This diagram shows an inefficient oil burner installation that results in large expense and suggests an improvement that would save money.

Tips from a Veteran Carpenter

Secrets About the Selection and Use of Materials That Will Save You Money When You Build Your Home

By JOHN R. McMAHON

"WHAT advice would you give a greenhorn on building a house?"

"That's a fine question," snorted Uncle Ed Warner.

"In what way, if you don't mind telling?"

"Every which way. It's like asking what advice a landlubber needs to become a navigator. Kind of a lifetime job, seems to me."

"You're right as usual, Uncle Ed," I assured the old man. "Still, there are some special tips a veteran like yourself might give to a beginner. Something that isn't in all the books and that you have dug out of your long experience in building."

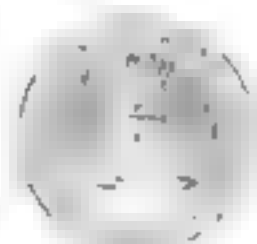
"Maybe so. Wait till I carve this plug and get my pipe loaded. Let me tell you that smoking tobacco these days."

While Uncle Ed labors to stake his dudhies in his own deliberate and silent fashion, I have a chance to inform the reader that this man is the wisest carpenter in our town. He has first-class tools and keeps them sharp and shining. He uses a steel square to do things that a mathematician would need half a blackboard to express. His pet saw is two inches wide, having been ground down to that narrowness by decades of honorable service. It has sawed carloads of lumber, including species of trees now virtually extinct, and might be considered the owner's postgraduate diploma and proof of master craftsmanship.

"Well, I'll tell you something that isn't in all the books," resumed Uncle Ed when his pipe was drawing satisfactorily.

"Go ahead and just imagine you're talking to the rawest greenhorn," I encouraged.

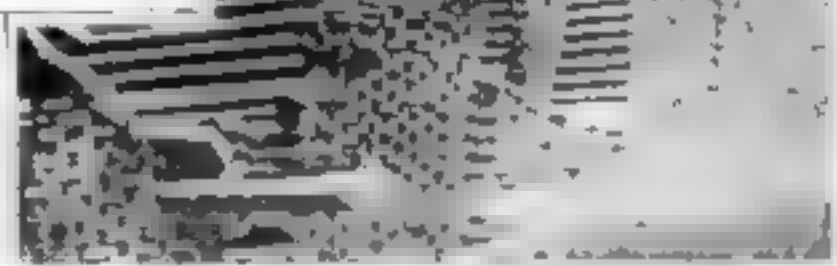
"It's the question of using seasoned lumber in a house. If you build a house with well-seasoned lumber, it stays tight and solid for several lifetimes. I've seen many old Colonial houses of that kind. On the



EVERY man who builds, buys, or remodels a home occasionally runs into difficulties. Mr. McMahon's practical articles each month help to solve these problems. He will be glad to answer your questions on home construction, addressed to him in care of Homebuilding Department, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York.

other hand, houses built just a few years ago are full of cracks and loose joints that would take a barrel of putty to close up. Besides the looks, wind and weather go through the cracks and start the ruin of the building. The owner has to tinker and patch everything, and he sometimes blames the carpenter for the rank open joints that appear after a few years, when they are just due to the use of green lumber that has dried out and shrunk."

"Methods of seasoning lumber have been changed quite a bit since the old



Which of these two piles of lumber would you choose for your house? Taking the old black stuff in the pile at the left, advises the veteran carpenter: it is well seasoned and will not shrink or warp.

In any lumberyard, the best lumber is the dark, dirty, weather beaten layer at the bottom of the pile. The bright new "green" material at the top is likely to shrink and warp

days," I observed, as Uncle Ed paused.

"Yes. Time was when a tree was cut down a couple of years before it was sawed into lumber and that lumber was kept in a pile for air drying another two or three years. The stuff was seasoned right in that way. The scheme nowadays is to hustle a log from the woods to the mill, turn it into boards, shoot them into a high temperature kiln for two days, and then pile them into a car for shipment to some local dealer. You buy the boards that were part of a living tree a few months ago. They have so much sap and life in them it's a wonder they don't sprout on your house."



This modern Colonial house will live to a ripe old age because the wood in it, as in its old predecessors, was well seasoned against shrinkage.

UNCLE ED chuckled. "Willow siding that began to grow would be pretty neat along with mossy shingles. I won't charge anything for the idea. Well, the fact is that the ordinary kiln-dried lumber is not more than half dry or seasoned. It keeps on drying when put in a building and it shrinks and shrinks. I guess you know that

shrinkage is crosswise of a board or beam and not lengthwise to any extent. Warping is another trouble of green lumber, especially the flat grain stock, it is a first cousin to shrinkage, but not the same. Now we can allow for shrinkage in the framing of a house, so that it will settle evenly instead of sagging in the middle. We do that by taking care to preserve the same relationship between the horizontal and vertical members of the frame everywhere, so that when the beams and girders shrink the house will settle uniformly at the sides and center. That is a good reliable method. But I don't

weather-beaten old stuff at the bottom. White pine turns yellowish with age and other wood generally darkens. That's a sign of seasoning. Some of the old material may be checked or cracked at the exposed ends, which means extra wastage in cutting, still it's better than the brand-new shrinkable stock.

HOW about buying material ahead and letting it season at home?"

"That's a good scheme for small jobs or where you have storage room; and you can save money, too, by buying in the slack winter season. I do that myself, always keeping on hand quite a mess of lumber, from molding to boards. Every attic is half or three quarters empty and will hold a truckload of lumber. It's a fine dry place. Then you have the upper part of your garage, across the ceiling beams. It is a good idea to stack lumber with little strips to separate the pieces so that air can circulate all around them."

"The house painter is quite a scapegoat for shrinkage," I observed.

"Saving the bacon for the rest of us,"

laughed Uncle Ed. "I've heard an owner say, 'That scoundrel of a painter cheated me. Look at his careless work—didn't paint the joints in that matched ceiling for the porch. The bare wood shows in every joint.' Someone told him that the joint opened after the paint was put on, but he wouldn't believe that the painter had covered all the surface in sight at the beginning. Green lumber gives another black eye to the fellow with a brush when the paint he so carefully applied peels off in large patches like the skin of an onion."

"You mentioned warping as second cousin to shrinkage."

"First," corrected the old craftsman, "and sometimes I think they're blood brothers. The first antidote for warping is to use quarter sawed or edge grain stock, whether in shingles, trim, or flooring. Of course, seasoning counts, too."

THEN it makes a difference in a new building whether the plaster is thoroughly dry when the finish woodwork is put in. A hurry-up job, with the trim

slapped on when the house is still damp, invites warping trouble. That reminds me of a shrinkage point. The owner of a new house wants the doors and windows to work easily. Let me tell him it is better to have the doors and windows tight enough to need coaxing if not downright wrestling to operate. Such a snug fit is a nuisance for a couple of years, but when the lumber has shrunk, everything is just right. A new house needs to be broken in the same as a car.



Mixed clapboards on the corners of a house, as shown above, look best, but other methods are just as good from a practical standpoint.



Don't trust to the painters to make the tops of exposed windows sun tight says the veteran carpenter. Make sure they are by using metal flashing on the drip caps. A dollar's worth of copper flashing on a window will save ten dollars in repairs.

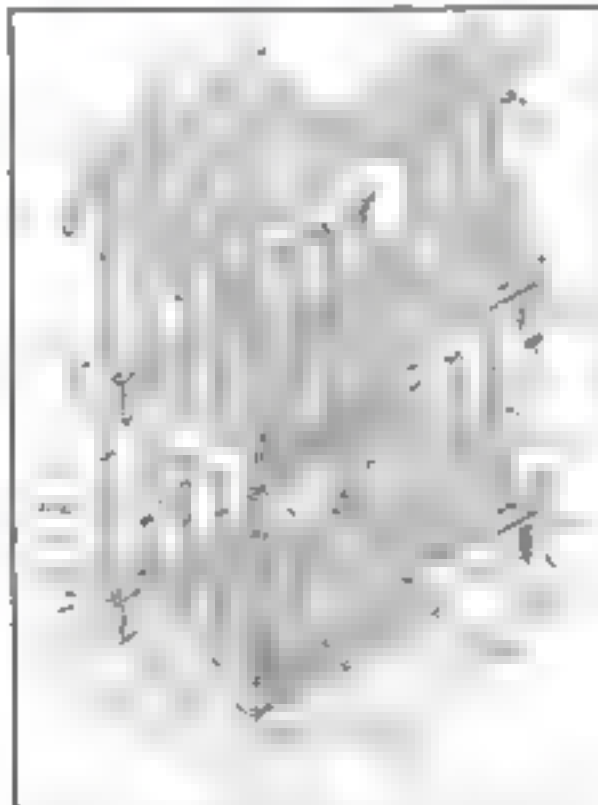
know any recipe to stop the shrinkage of green boards and trim. Shove them tightly together, nail them fast, yet they pull apart in time."

"There's some difference in the kind of lumber," was my comment.

"Not enough to count. I have a white pine table made of square edged boards that were tight together a few years ago, but now they are an eighth of an inch apart. Matched spruce on an outbuilding kept painted shows daylight between every pair of boards. Cypress and long leaf yellow pine are special old pals of mine, still I have to admit they shrink. I worked on a house not far from here and the oak flooring was a handsome job when it was new. After three years the oak strips had shrunk so much that the tongues were pulled clear out of their grooves. It took a lot of crack filler to patch that job, and then it was a poor imitation of a first-class floor."

CAN'T you tell green lumber when you see it or saw through it?"

"Some may pretend to, but I don't," replied Uncle Ed. "A piece of wood doesn't have to drip water or be sticky in the saw cut when it is unseasoned. The moisture is in the pores. The principal safeguard is to buy your stuff from a reliable dealer. You depend on him not to hand you raw lumber fresh from the car. He has a large stock in reserve that seasons slowly in the yard, better under cover. You can also use your own eyes and turn down the bright, fresh lumber on top of the pile. Look for the dusty



Courtesy National Lumber Manufacturers Association
How the frame of a well-built house is constructed. Studs and joists are spaced 16 inches apart. Rough floors and sheathing are laid diagonally for strength; exterior walls braced.



If the strips of an oak floor are not well seasoned before laying, they may shrink until wide cracks appear between them, necessitating repairs.

and people should be willing to stand a little inconvenience in either case.

"Doesn't the kind of wood make a difference in warping?"

"That's right. White pine, cypress, and cedar don't twist around as much as most other kinds of wood. I have seen on the outside of a house a piece of maple molding that had torn itself loose from the nails and curved out like a snake, wriggling as if it was alive. What was maple doing outside? Of course it had no business to be there. This is something to warn the public on—how careless or crooked builders slip in any kind of lumber for trim. (Continued on page 153)

Do You Know How Your Icebox Is Built?

Improper Insulation the Cause of Poor Refrigeration, Our Tests Show

By R. D. MORRILL, M. E.

In Charge of Refrigerator Tests for Popular Science Institute of Standards



HOW much did you pay for your icebox? That question is mighty important because it involves both your health and your pocketbook.

Although the United States uses far more iceboxes than any other nation in the world, ~~experts~~ ^{experts} ~~have~~ ^{have} ~~developed~~ ^{developed} the Popular Science Institute of Standards have developed the alarming fact that most of these iceboxes are practically worthless for preserving purposes.

Because they are incapable of maintaining the low temperatures required to arrest the growth of bacteria, food spoils in them almost as fast as it would on the shelves of a closet. The dangers of such spoilage have already been discussed in this magazine by a medical expert. Next to health, waste is the most important problem in domestic refrigeration. A poor icebox wastes an unbelievable amount of food and ice.

In principle, an icebox is a simple apparatus. It consists of an outer shell, or casing, and an inner shell, or lining, the space between the two shells being filled with material that is a poor conductor of heat. Then why, you may ask, if it is so easy to make an icebox, does any manufacturer turn out a poor one?

The answer is contained in one word: price. Though the principle of the icebox is simple, good iceboxes are expensive to make and manufacturers are forced to regulate the quality of their product to suit the prices the public is willing to pay.

THERE are, of course, "gyp" icebox manufacturers who charge big prices for ornamental but useless refrigerators, but the reputable manufacturers turn out the best iceboxes they can make for the prices they can get.

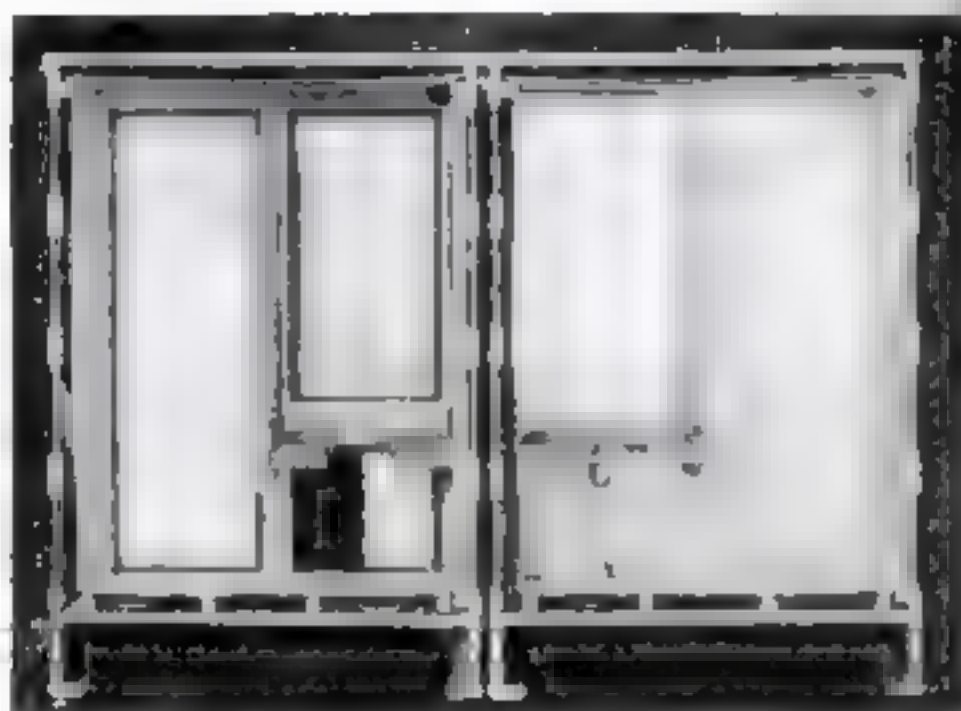
If you are unwilling to pay the price which a manufacturer

must ask for a really efficient refrigerator, you will get an icebox built as were the three shown in the accompanying illustrations. These iceboxes cost at retail \$36, \$49, and \$61.

TESTS at the Popular Science Institute of Standards demonstrated that not one of them was capable of maintaining a food preserving temperature during summer weather. Each of them was tested for efficiency in a room where any temperature between freezing and 120° can be maintained constantly for any length of time desired, regardless of outside weather conditions.



Photograph 3. Cork insulation an inch and a fraction thick. Outside temperature 80°; inside, 56. Cork should be at least 2 inches thick.



Photograph 2. Two layers of felt, an inch of air. Outside, 80°; inside, 64.



Photograph 1. Thin felt and ground cork insulation. Outside temperature 80°; inside, 59.

When you buy an icebox, you pay for construction, fittings, appearance, and efficiency or good heat insulation. The three iceboxes illustrated meet these requirements in every detail except one—proper insulation.

TO MEET the prices at which the boxes were sold, something had to be skimped and the manufacturers economized on insulation, because the insulating material being placed between the inner and outer shells cannot be seen without tearing the icebox to pieces.

Before these boxes were taken apart, the differences in the amounts of insulating materials they contained were indicated by the Institute tests.

The best of the three boxes, the one illustrated in Photograph 3, had solid cork insulation averaging a fraction more than an inch thick. Cork is one of the best insulating materials, but an efficient icebox requires at least two inches of cork.

When the temperature was held at 80°, this icebox maintained an average temperature of slightly more than 56°, or 6° above the point where bacteria begin to multiply with alarming rapidity.

The icebox in Photograph 1 is a less efficient refrigerator. A space of about an inch between the outer and inner shells contains two thin layers of felt and the rest of the space is filled with ground cork. This, of course, spilled all over the floor when the investigator's saw cut through. With an outside temperature of 80° this box maintained an inside temperature of more than 59°.

The ice- (Continued on page 142)



A 6 in., \$50-piece sterling silver trophy with track exhibited by Alex Hammar, veteran silversmith who made it as a trophy for the Chicago student prevention campaign.

Model Railways Rival Real Ones

Amazingly Complete Systems With Tiny Locomotives Using Their Own Power Used to Teach Transportation Methods

By L. G. POPE

TINY steam railroad locomotives that burn real coal and yet are no longer than your foot—miniature Pullman, baggage, and freight cars perfect in every detail—tracks, signal towers, switches, and other railroad equipment exactly like their full-sized prototypes are being produced by the patient skill of model makers in all parts of the world.

So realistic are some of these model railways, and so complete are they in every detail, that photographs of them can hardly be distinguished from photographs of real railroads.

This fascinating hobby, model railway building, appeals most strongly, of course, to men who have, at some time in their lives, been connected with a real railroad. But the lure of the shining rails and the steel monsters that travel on them seems to ensnare thousands of people who have never had any connection with a railroad beyond riding as a passenger.

There is, for example

a middle-aged clergyman living in a quiet rectory in the south of England who has produced some marvelous examples of the model builder's art, both in railroad locomotives and in various types of stationary equipment.

And there is C. A. Lehman, an instructor in the schools of Long Beach, California, who has constructed what is

said to be one of the most perfect sets of transportation models ever built. These locomotive models, capable of running under their own power, portray the development of railway transportation over a period of 100 years. They range all the way from a model of the Tom Thumb built in 1828 for the Baltimore and Ohio Railroad to a model of the

gigantic modern Union Pacific three-cylinder passenger locomotive.

Crossing the water again, we find E. P. Keen, of London, Chairman of the Model Railways Club, who has spent years on the construction of a remarkably complete model railway. Practically every common type of rolling stock is duplicated in miniature on his model railway. All the varieties of "goods wagons," as freight cars are called in England, are standing on the sidings of his railway.

WHILE most model railway construction is done as a form of recreation, many models



Models, large and small, of almost everything that runs on rails, made by experts and exhibited and explained at a recent English exposition held in Kingsway Hall.

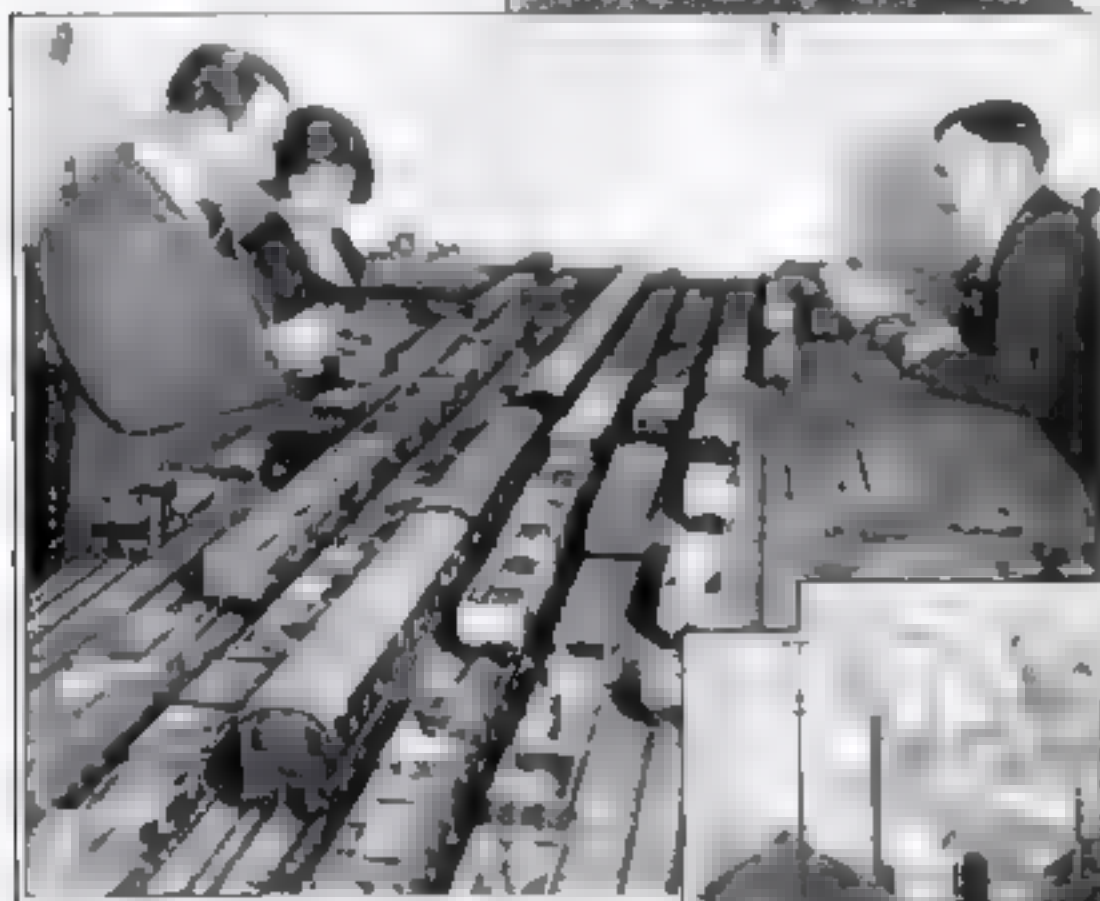
are built commercially for exhibition. One of the most beautiful of such models was recently completed by a firm in Chicago, Illinois. It is a model of a street car, made accurately to a scale of three quarters of an inch to the foot and is perfect in every detail. It is built entirely of sterling silver.

In his constant striving for accurate small scale reproduction the enthusiastic model maker seems to be willing to go to almost any amount of trouble. It appears to make no difference how much work is involved or how long the work will take. The main requisite is true scale modeling.

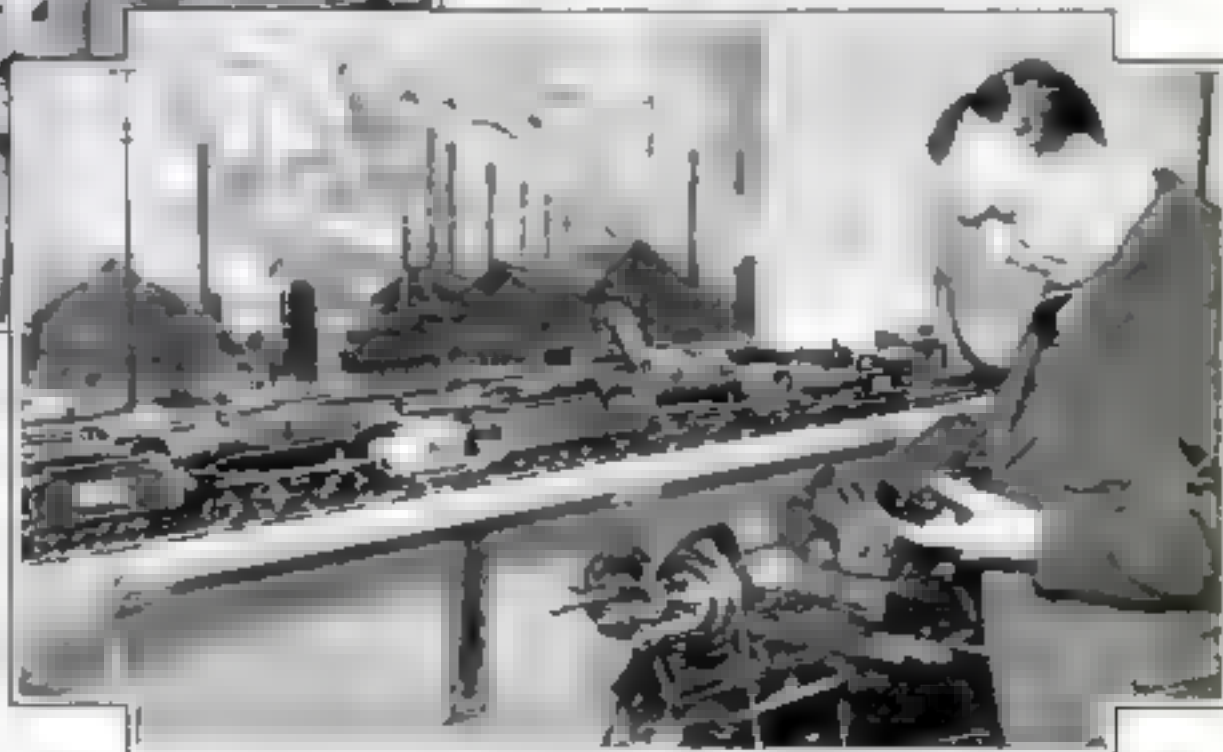
Foot track laying, for example, the really good model makers procure special brass or steel rails, rolled to a cross section just like those of real rails. These rails are applied to wooden ties according to American standard practice or held in chairs by wooden wedges according to the English system.

Switches are constructed from the plain ends to duplicate full sized construction.

Even the hooch of the tiny atomic locomotives are held

[illegible]

Let A complete model railroad system all their by hand and complete after years work by E. P. Kees. Chairman of the Model Railway Club of England and Mrs Kees who are seen in the photo with a friend looking over part of the system.



H. P. Keen repairing an engine tender of the most complete model railway in the world, a marvel of accuracy and detail. This photograph shows part of the yards and the scenic background.

together with rows of almost invisible rivets. They are, in fact, true models of their gigantic prototypes!

The power of some of these small locomotives is astonishing. Engines suitable for operating on track measuring but two and a half inches between rails are capable of hauling a load of several men riding on specially constructed flat cars.

Model railway building naturally develops skill in the use of tools and a surpassing degree of ingenuity in working out constructional problems. But the chief requirement of all is patience!

Plane Races with Crack Train



The locomotive *Flying Scotsman* which claims the world's record was not half fast enough for the airplane *City of Glasgow* when the two recently raced 400 miles from London to Edinburgh. But it was a stirring spectacle as they passed over Berwick Bridge.

What Do You Know About Aviation?

1. When, by whom, and where was the first flight accomplished in a heavier than air machine with power?
2. How were the early airplanes made to take off?
3. What department of the U. S. Government is charged with regulation of interstate air traffic?
4. What country leads in the number of airplane passengers carried?
5. What is the difference between a rotary and a radial engine?
6. What is a tachometer?
7. What is an airway?
8. What is a supercharger?
9. Why is an airplane engine costly?
10. What causes the so-called "bumps" in flight?
11. What is the scheduled time of the air mail from New York to San Francisco?
12. Which is the safer flying, high and fast or low and slow?
13. How can one be assured of a safe airplane "joy ride"?
14. What is the official distance covered by Lindbergh in his New York to Paris flight?
15. What is a sock?
16. Who accompanied Commander

HERE is a chance to find out how much you really know about aviation. These questions were compiled for readers of POPULAR SCIENCE MONTHLY by Professor Alexander Klemin, Director of the Guggenheim School of Aeronautics at New York University. The average person should be able to answer fifty percent of the questions. Test yourself. Then try the list on your friends. The answers are on page 122.

Byrd in his flight over the North Pole?

17. What are the two main types of airplane wing structure?
18. What is an ornithopter?
19. What are the advantages of a monoplane over a biplane?
20. Is a hydroplane an aircraft?
21. What is the fin and its function?
22. What is the stabilizer and its function?
23. What is an aileron and its function?
24. What is a cowling and its use?
25. What is a parasol monoplane?

26. What are longerons?
27. Of what materials are propellers made?
28. What is a strut?
29. What covering is usually used for airplane wings?
30. What section of the United States furnishes our principal supply of airplane wood?
31. Why is steel used in fuselage construction more generally than duralumin?
32. What change in design is advisable when brakes are used in the landing gear?
33. What is a streamlined wire?
34. What is a glider?
35. What is the weight of a cubic foot of air at sea level at 32 degrees F. temperature?
36. What effect does a decrease in air density have on flight?
37. Which furnishes the greater part of the lift, the upper surface or the lower surface of the wing?
38. Why is the long dimension of the wing always put across wind?
39. In what direction relative to the wind should an airplane land and take off?
40. For what are wind tunnels used?



Mrs. Richard E. Byrd, who considers it sheer folly to have so her husband a man so valuable to the world. Right: Commander Byrd, on the occasion of his receiving the honorary Doctor of Arts degree at the Pennsylvania Military Academy.



Three children of Commander Byrd are seen at play in the Boston Public Garden. They are, from left to right, Catherine Byrd, Bolling Byrd, and Richard E. Byrd Jr.



DICK BYRD—Adventurer

An Intimate Study of the Great Explorer at Home—How He Plans an Expedition—Why He Is Going to the South Pole

By FITZHUGH GREEN

"**H**E IS still sleeping," the maid told me when I came down to breakfast at eight o'clock. I was spending a whole twenty-four hours with Commander Richard E. Byrd at his home in Boston to see exactly what such a man does when he is not flying over some Pole or on some other exciting adventure, and the girl's words seemed to indicate that this was a lazy man.

But he isn't lazy. It is merely that in working and in living he practices sane economy. He doesn't plunge into his work nervously, making much haste and little speed. His inclination is to take things easily and do the important jobs in systematic order.

Just after nine he appeared, perfectly groomed in close-fitting blue serge, his

HERE is the answer to a question that has been asked over and over again—What does Commander Byrd's wife think of these trips of his? And in this, fifth and last in a series by Commander Green, himself a famous explorer, are never before published facts about the South Polar expedition.

dark eyes clear and snapping after nine hours' refreshing sleep.

"Sorry, old top," he apologized laughingly, "for not showing up sooner."

"Why worry," said I. "My breakfast was waiting for me, if you weren't."

He laid his hand on my arm and spoke into my ear as if imparting an important secret—which he was.

But it's sleep that makes the breakfast taste good, isn't it?"

A typical remark from Dick Byrd. For to him health goes before all else. I have seen him turn down money to get an extra hour of sleep; refuse a banquet to avoid breaking training; deny an interview with an important man rather than miss his daily exercise.

Yet few men can equal Byrd in sacrificing sleep when necessary. On the Greenland trip he flew across Ellesmere Land three days in succession with an average of about three hours' sleep each day. He hopped off for the North Pole with only two hours' sleep. Before he crossed the Atlantic by air in 1927 he went to bed at two A.M. and got up at four A.M. to remain awake for more than forty-two hours!

On this day at his home he did a characteristically seafaring thing before



A test at The Pas, Manitoba, of the Ford all metal pump for the Commander Byrd's expedition in Antarctic waters. Its wheels are being replaced with skis.

he sat down to his breakfast. He took a squint at the sky and glanced at the barometer.

"In for a bit of wind he observed.

I glanced out on the unruffled surface of the Charles River which mirrored a cloudless sky, but Dick was right—in two hours the sky was overcast and the bay ruffled by a stiff east wind.

He ate heartily—and slowly, taking time not to listen to a boyish yarn by Dick, Jr., to exchange a kindly word with the maid, to share a snoutful now and then with Igloo, his favorite dog. He had orange juice, hot cereal, two eggs, toast, and tea.

"Don't use coffee," he replied to my question. "A man can travel farther and work harder on tea. In fact I like hot chocolate best of all."

I took this to be his attitude towards all stimulants—use them sparingly or not at all if you expect to get a lot out of the body as a machine.

Now came another small formality—the morning paper.

"I like to know what other people are doing," Dick explained. "And after all, the most interesting thing in life is people—don't you think?"

BREAKFAST and morning paper took about forty-five minutes. By this time his secretary had arrived and opened two mountains of mail in his small office in the front of his house. "And more out in the hall," she told me.

Dick came in with a cheery "Good morning." The secretary flashed a smile in reply, but turned almost instantly to her shorthand book. I understood why, for Byrd had a letter in his hand and was dictating a reply even before he sat down.

That is one of the misleading things about the man. Because of his soft southern drawl and bland manner you are likely to think of him as anything but



The Thompson, chosen to carry Commander Byrd and his fifty-odd men with dogs and planes to the Ross Sea ice barrier. The ship will then return to New Zealand and the explorers will work southward toward the Pole and establish a permanent base.



Arthur T. Welden, in charge of dogs of the South Polar expedition, shows funnel-like entrance of the tents he devised for the party.

a man of action, but you are wrong.

"I deeply regret that it is impossible," he snapped out. "There are at least four good reasons . . ." With almost mathematical precision he enumerated the arguments against his doing what the writer of the letter requested.

He may handle as many as 300 letters before the day is over.

It is a chore in New York, which he visits every few days, his mail is likely to be even larger, and his visitors more

And then

After an hour with his secretary he has his first visitor. This may be almost any kind of person, today it is a scientist with a scheme for an expedition after Byrd has come back from the South Pole.

BYRD smiles. He is used to this sort of thing. Gently he disposes of the caller always making a friend rather than an enemy. Then the next visitor, and so on for three hours.

At noon comes the daily walk followed by luncheon at one. The afternoon is even busier, but it, too, ends in exercise—golf, tennis, squash, swimming, or boxing. In the evening he lectures, writes, reads proof, or confers with his staff.

But what of his charming wife and four lovely children? What do his adventures mean to them?

"There must be something wrong with a man who would go off and leave his family!" exclaimed one lady to me when she discovered that the famous air explorer was married.

I inquired why.

"Because he leaves them for months and months. He risks his life time after time. And what do they get out of it all?" The best answer is in Mrs. Byrd's viewpoint.

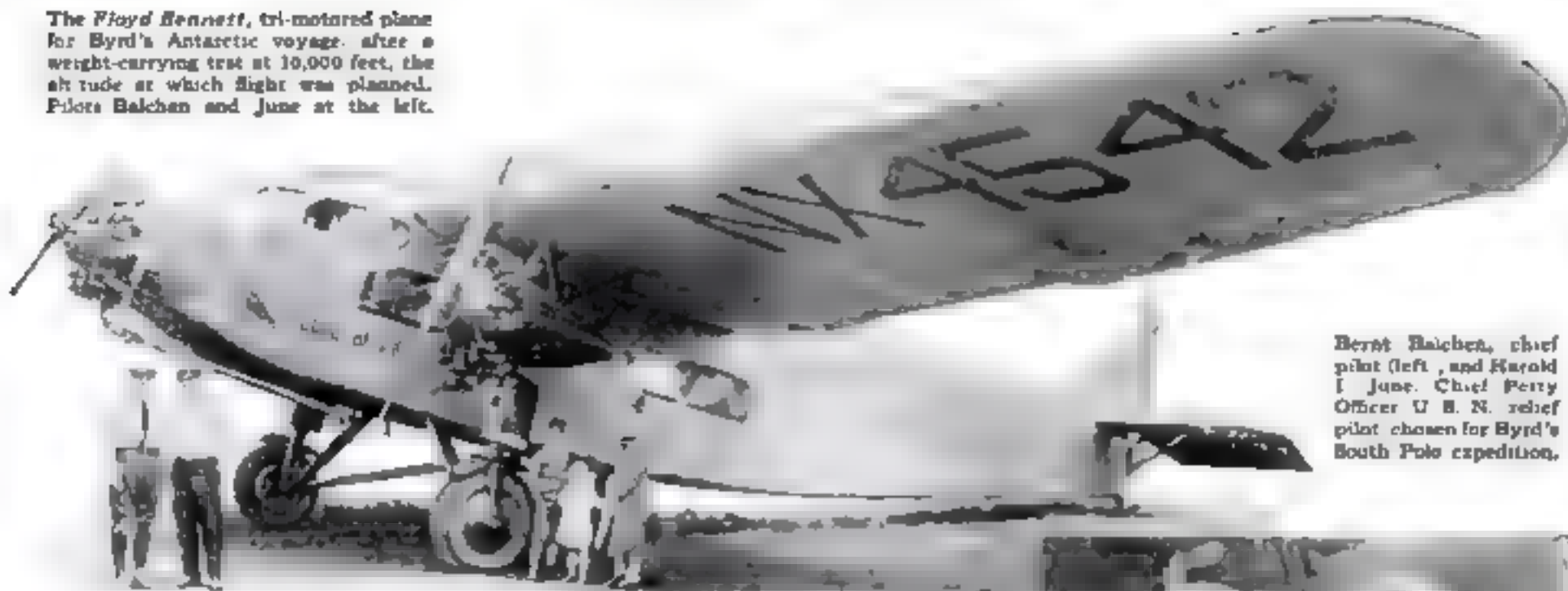
"There is no use trying to analyze a man's reasons for being an explorer," she said, when I asked her about it. "But if he enjoys his work and does it well, he is filling a niche in human endeavor that some one has to fill. I feel I'm lucky to have a man chosen by fate for so valuable a duty."

SHE vigorously lives up to that philosophy by working elbow to elbow with her husband. Yet not for a moment does she neglect her children. Indeed, she is as competent a mother as ever lived. And she is as free as Byrd from that miserable avarice which keeps most of us chasing the almighty dollar.

They live modestly. He gets about \$4,000 a year Navy retired pay. He owns a small brick home. He has written one book and about a dozen magazine articles in two years.

"But doesn't he make a lot out of his lectures?" I am asked. Yes. So did Peary and Amundsen and other explorers. But, like them, he feels that such

The Floyd Bennett, tri-motored plane for Byrd's Antarctic voyage, after a weight-carrying test at 10,000 feet, the altitude at which flight was planned. Pilots Balchen and June at the left.



Bernat Balchen, chief pilot (left), and Harold G. June, Chief Petty Officer U. S. N., relief pilot chosen for Byrd's South Pole expedition.

money should go back "into the business." In other words, he is one of the biggest subscribers to his own scientific expedition.

There are plenty of chances for Byrd to make quick money if he chose.

I was present once when \$100,000 was offered him for the news rights to an historic flight, but there was no guarantee that Dick's companions' writings would be purchased.

"Sorry," said Byrd, "but I can't do it. They have families as well as I." His eyes twinkled. "Then you know, sir," he added, "their stories will probably be better than mine."

DICK BYRD'S great work at the present moment is preparation for his flight across the South Pole. Shortly after this will appear in print he will steam in the little ice ship, the *Sampson*, through the Panama Canal and thence down to New Zealand to make his last stop before crossing the Antarctic Ocean for the South Polar regions.

In preparation of this article I asked him why he was going to fly over the South Pole. For reply he penciled the following paragraph:

"There lies down there at the bottom of the world a vast unknown region as big as the United States and Mexico combined, that the eyes of man have never

looked upon. That great unknown area is in the clutches of an ice age—a glacial period such as existed in this country of ours ages and ages ago. And so it is that this ice-covered land is a great mystery, and offers the last great challenge to the aviator and the explorer.

He went on to remind me that Antarctica is a continent surrounded by a barrier of ice in most places 300 feet high. This is quite different from the North Polar area which is surrounded by the Polar Sea some 9,000 miles in diameter.

"We know," he went on, "that fierce gales spring up suddenly and last for days. We know that in places the average wind velocity has been over fifty miles an hour for a long period, meaning that winds must rise as high as 130 miles an hour at times."

Since the temperature goes down to seventy degrees below zero, the cruelty of such gales can be imagined.

"We are taking about fifty-five volunteers from more than 3,000 applicants for the expedition, seventy-five Eskimo dogs, and two North Greenland Eskimos.

"We shall have with us three airplanes. These we shall use to lay out a line of supplies southward from our base on the Ross Sea ice barrier. This barrier is a solid hunk of ice 400 miles wide, 500 deep, and rising from a few feet to 300 feet above the level of the sea."

He did add what is to me a most interesting point. When Scott and Amundsen went down in 1911 they based near together, the former refusing to put his camp where Byrd will put his. Scott felt that there was some danger of the ice tongue breaking adrift and carrying his entire base with it out into the Antarctic Ocean. Byrd knows this, but with characteristic courage looks on it as one of the acceptable hazards of exploration.

"**THERE** we will build a self-sustaining town, while our vessel goes back to New Zealand for the winter," he went on.

This means that during the black six months' Antarctic night he and his men will be cooped up in that icy desert with the howl of the blizzard overhead and the ominous crackling and booming of the ice beneath their fragile huts. It means



that for six months this half a hundred men must keep house, cook, sew, scrub, nurse, and do all the other things which a bachelor must do, isolated at the ends of the earth.

When the sun comes back it will bring with it more severe cold than ever. "When the days begin to lengthen, the cold begins to strengthen," runs the old Klondike proverb. But light of the Polar dawn will enable dog sledges to go out southward even before the planes can be put into commission. And by the sledges the food depots will be checked up and dug out from the drift of winter snow.

FINALLY, the great southward flight will be attempted with the big three-motored Ford plane. First there will be a traverse of some 400 miles over a gradually ascending field of snow-covered glacial surface; then a sharp rise of about 5,000 feet between the mountains discovered by Scott, Shackleton, and Amundsen. Thence a direct flight to the South Pole which lies at the center of a vast and frigid plateau at an elevation of about 11,000 feet.

This flight will constitute the most spectacular phase of the whole enterprise. It will not amount to any new achievement, save as another proof of Byrd's boldness and the airplane's competence as an aid to exploration. But after it is finished will begin the more exciting work, even though it (Continued on page 140)



William C. Haines, Weather Bureau meteorologist, chosen for the Byrd expedition, with some of the instruments he planned to employ.

The New Radio Sets Offer—

Higher Values—Better Tone, Selectivity, and Volume—Lighted Dials—Dynamic Speakers

By JOHN CARR



RADIO today presents a strikingly novel situation. Tremendous improvements have been made in the last year—more, perhaps, than in any recent year—and yet these improvements have all been accomplished without the aid of any basically new invention or discovery.

Radio sets of different makes are becoming more alike in external appearance, and in many cases in the interior arrangement of the apparatus as well. And in the sets designed to be given to the public this Fall and Winter, there has been a marked abandonment of freak ideas.

Undoubtedly the most notable recent improvement has been in the development of faithful tone reproduction. Even the lowest priced of the new radio receivers offer a tone quality unobtainable from even the most expensive sets a few years ago.

All the other new refinements tend to make the modern radio receiver simpler in operation, more attractive in appearance, easier to tune, and more selective.

About this time last year, an article in POPULAR SCIENCE MONTHLY heralded the coming of the full electric set, the radio receiver operated entirely without the aid of batteries. At that time there were three distinct systems for full electric operation. These systems consisted, essentially, of operation by means of vacuum tubes with the filaments heated by low voltage alternating current, operation with battery type tubes connected in series with an overgrown B-eliminator to supply extra current for the filament circuit, and operation with battery type tubes where the current was supplied by a combination A and B eliminator.

OF THESE three, after a year's trial, operation with the so-called A. C. tubes has proved most popular. Practically every new model is of this type and the development of good A-B eliminators has made possible the conversion of many old battery sets to full electric operation.

Most of the newly designed sets use A. C. tubes of the 226 type for the radio-frequency stages and the first audio stage, a type 227 tube for the detector,

and a 171A, a 210, or even a 250 for the last stage. A few are using heater tubes similar to the 227 in all stages. Power tubes are now universal, nothing less powerful than the 171A being supplied.

In radio frequency, detailed refinements have noticeably improved the average receiver's ability to bring in distant stations and to choose between them. Single

Attention to the details of coil design and shielding has minimized the troubles caused by magnetic and electrostatic coupling. This means that the new sets are easily balanced, and a squealing, howling set that disturbs everyone in the neighborhood now is almost a thing of the past.

The tendency to consider the radio receiver as a piece of household furniture as well as a piece of electrical equipment has had a strong influence on the design of the cabinets in which the new models are housed.

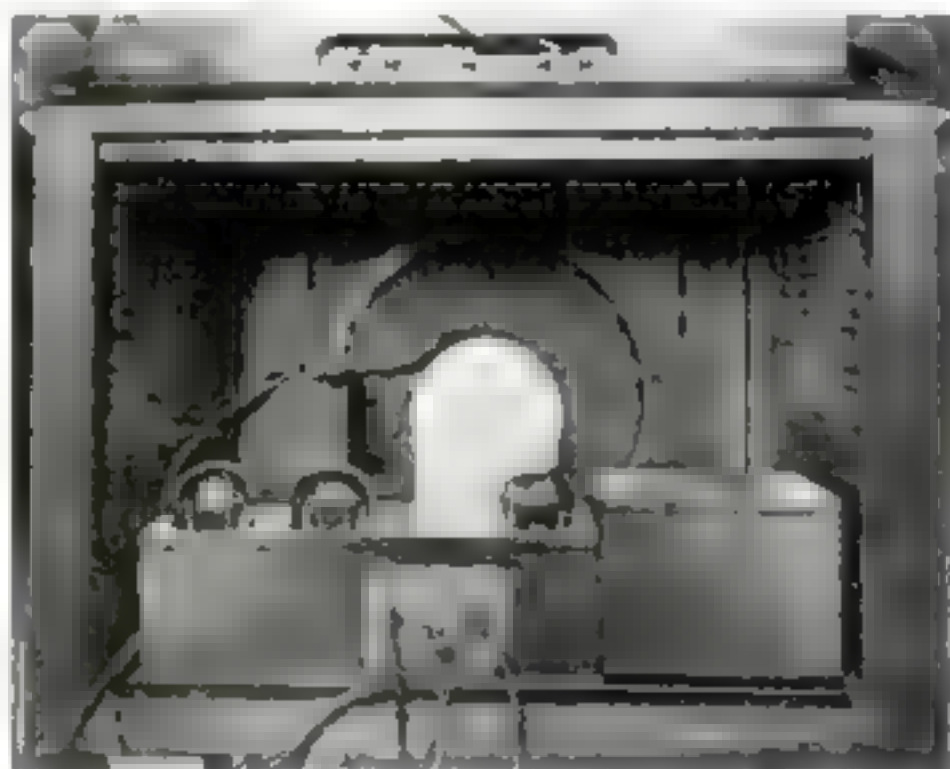
THE chassis system of receiver construction is now almost universal. Many concerns are producing a single type of chassis which is sold mounted either in an inexpensive metal cabinet or in more pretentious wooden cabinets or console tables with built-in loudspeakers.

Marvelous improvements have been made in the finishing of the metal cabinet surfaces to imitate wood, leather, or almost any other material. These finishes will resist rust in damp climates where warping eventually will ruin any but the most expensively constructed

wooden cabinet. And of course the underlying reason for the widespread use of metal cabinets is one of cost. All the new models are compact, but this compactness has been gained by careful engineering design rather than by crowding parts together without regard for efficiency.

VIRTUALLY all the lower priced new models are self contained. The single small cabinet houses both the receiver proper and the power unit, which consists of a conventional B-eliminator circuit plus extra windings on the power transformer to take care of the filament current requirements of the alternating current tubes.

This all-in-one type of construction has given rise to some confusion in the classification of radio receivers. In the days of the battery operated set the number of tubes denoted the number of stages in the set and was, therefore, a rough measure of its capability. For instance, a five-tube set consisted of two tuned stages of radio-frequency amplification, a de-

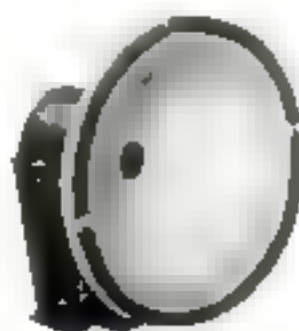


An inside view of the most powerful combination dynamic loudspeaker and power amplifier now available, complete in a console table. At the left are the two UX 250 power tubes that are used in a push-pull circuit.

dial control now is a matter of course.

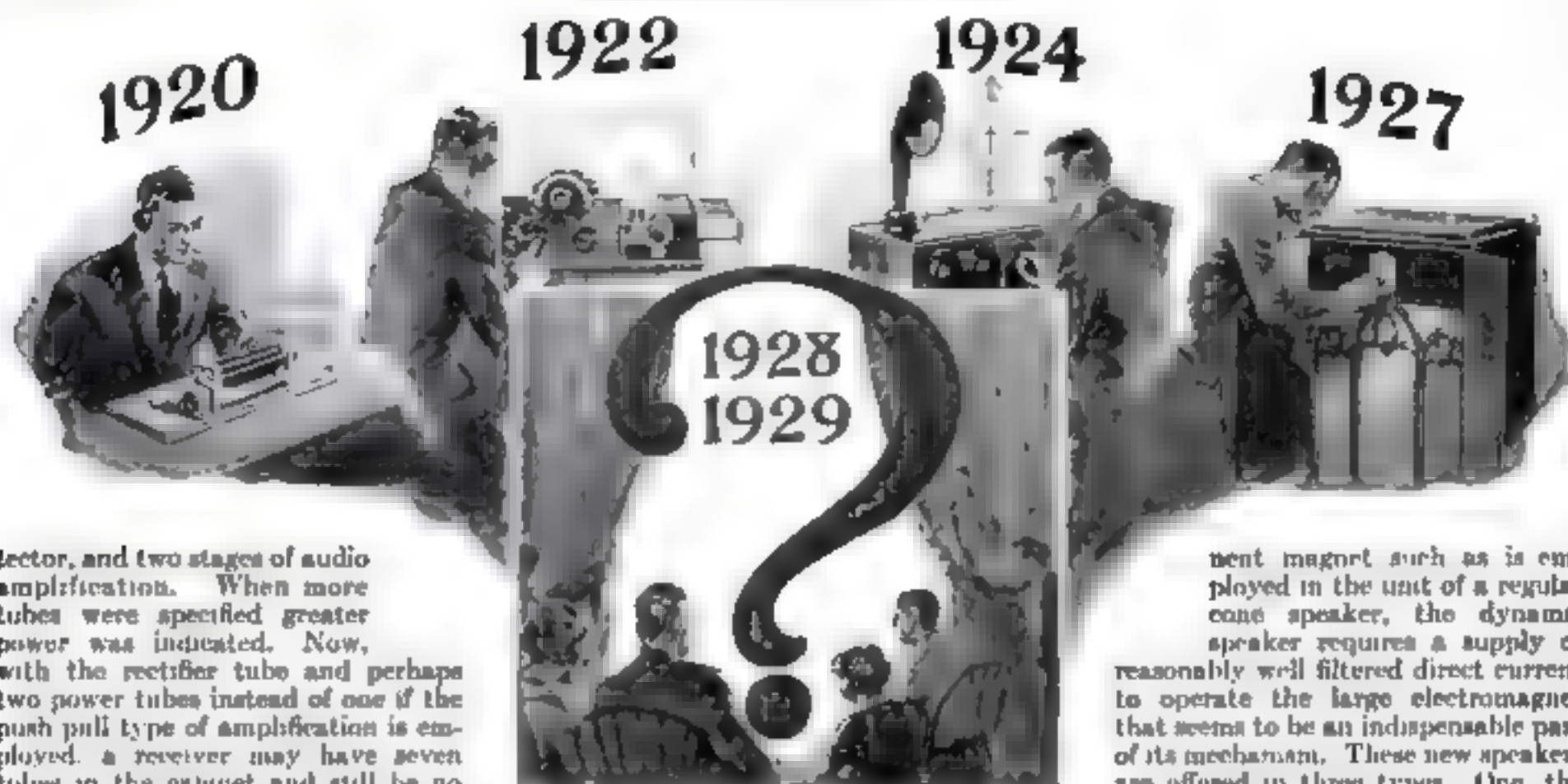
Like the gear shift on the automobile, which after years has finally become standardized, the control of a radio set has nearly reached that state. The standard now is one knob to control tuning, another to control volume, and a simple snap switch to turn the set on and off. Some highly refined sets have additional controls for use only in searching for distant stations when an exceptional degree of selectivity is needed.

Careful shielding is an integral part of all new receivers. Losses due to shielding have been largely overcome by a more careful attention to the design of the coils and a greater appreciation of the need for adequate and accurate spacing.



Left: Dynamic speaker unit for use on battery current. Right: The same unit with a built-in rectifier to allow operation direct from the light circuit.





lector, and two stages of audio amplification. When more tubes were specified greater power was indicated. Now, with the rectifier tube and perhaps two power tubes instead of one if the push pull type of amplification is employed, a receiver may have seven tubes in the cabinet and still be no more effective in bringing in distant stations than a good five-tube battery set. It is well, therefore, to investigate this point before you buy a new set. Disregard the total number of tubes in the set and find out how many tuned stages of radio-frequency amplification there are, figuring one variable condenser for each stage.

The new sets seem to go to the ultimate limit in volume for home use. Any person not stone deaf can get from them enough volume, without loss of tone quality, to satisfy any possible requirement, even including broadcasting to a large hall filled with people. With the most powerful outfit produced this year you can get considerably more volume from the reproduction of a brass band than you could get if the band itself were present.

AND the tone quality even with this enormous volume is startlingly realistic and lifelike. The deepest notes of the organ boom forth like rolling thunder and the high-pitched shrill of a piccolo is equally well reproduced.

Of course, the modern sets designed for tremendous volume are in the high priced class. But complete range of volume with good tone quality is available in most of the new models. The least expensive types use a single 171 type tube in the last stage. Next come the outfits fitted with two 171 tubes in a push-pull circuit. Others use one 210 tube or one 250 tube, while greatest volume can be obtained from a deluxe receiver utilizing two 250 tubes in a push-pull circuit! A view of the lower compartment of this receiver is shown in one of the accompanying photographs. It is at this writing the most powerful broadcast receiver available.

The loudspeaker is intimately connected with the problem of good tone quality. Even the best set is useless

The new art of radio broadcast reception has advanced so astonishingly that receivers approach perfection and further improvement will be difficult.

without a good speaker. Last year the cone type speaker was at the high water mark of its popularity and there are several reasons why it probably will retain its popularity for a long time, in spite of the fact that the new dynamic speaker threatens to do to the cone what the cone speaker did to the old-fashioned horn—push it into oblivion.

UNFORTUNATELY, space limits forbid my going here into the theory and constructional details of dynamic speakers and explaining how they differ from the conventional cone type speaker, but we hope to do this in an article to appear in an early number of *POPULAR SCIENCE MONTHLY*.

There is no question, however, that under certain conditions the new dynamic speaker will outperform the best cone speaker. The requirements are, briefly, that the radio receiver be particularly good, and that it be fitted with a power amplifier.

The dynamic speaker is a power operated device. Instead of using a perma-

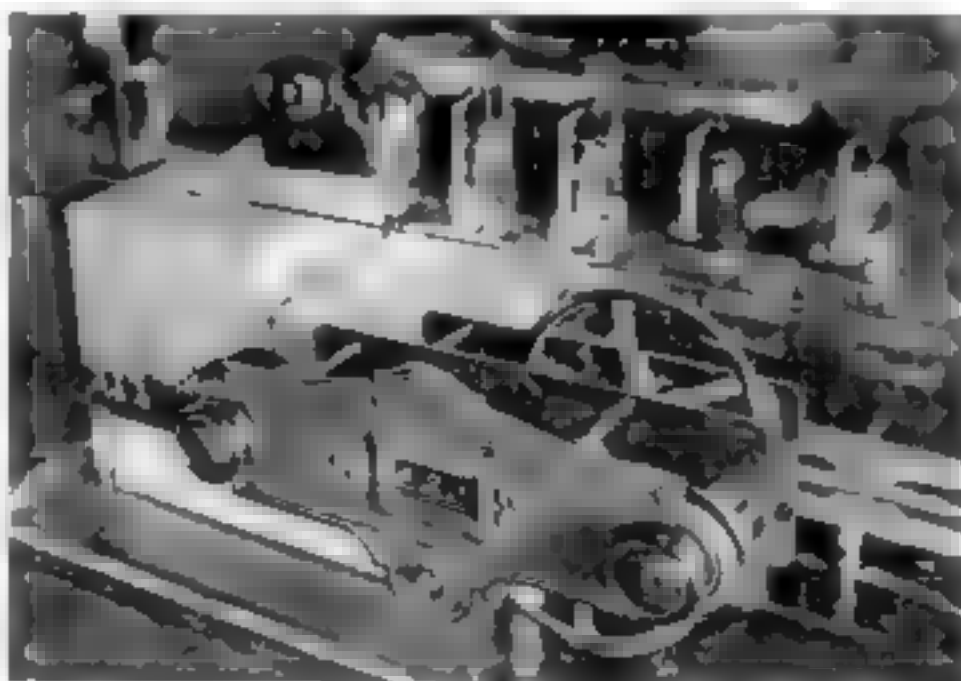
nent magnet such as is employed in the unit of a regular cone speaker, the dynamic speaker requires a supply of reasonably well filtered direct current to operate the large electromagnet that seems to be an indispensable part of its mechanism. These new speakers are offered in three types. One, the simplest, has a winding suitable for use on six-volt storage battery current. Another form is designed to utilize the return B-current of the eliminator. This type will produce a hum unless a really efficient B-eliminator is employed. The third type is fitted with a built-in rectifier unit.

Never before in radio have so many really excellent receivers been offered at such low prices. All the way from the least expensive to the most expensive models you can, this year, get exceptional value for your money.

In buying an electric radio receiver, note that the general practice now is to quote a price which includes the receiver complete except for tubes. The price of the loudspeaker also is included where this part of the receiving equipment is built into the cabinet. Battery operated radio receivers were priced less accessories, which meant that you had to buy a loudspeaker, tubes, A-battery, A-battery charger, and B-batteries or a B-eliminator.

However, keen competition and low prices make more important than ever the test work being done for your protection by the Popular Science Institute of Standards. The radio laboratory of the Institute is busy testing the various new models of radio receivers and loudspeakers being brought out at this season. While inferior design, poor workmanship, and low grade materials may get past a casual inspection, these deficiencies are sure to be revealed under the searching laboratory examination.

THE Popular Science Institute of Standards is conducted to guide you in your selection of radio and similar equipment. So before you buy be sure to find out if the equipment you expect to purchase has been tested and approved. Address your letters: Popular Science Institute of Standards, 250 Fourth Avenue, New York City.



One of the season's novelties—a direct-reading tuning mechanism. A system of gears turn numbers past the little window when knob is turned.

Helpful Hints for Radio Fans

Locating Trouble in a Set

Solder That Needs No Iron—Noises Tell What's Wrong—Long Loudspeaker Cords—Problems of Changes in Tuning Solved

FOR amateur radio experimenting the electric soldering iron is ideal, but there are times when to use one is almost an impossibility. Soldering a lead to the antenna while you are up on the roof, for instance, or making a connection between wires of a home telegraph line quite a distance from the nearest electric light socket, cannot conveniently be done with an electric iron.

Of course, a gasoline blowtorch is excellent for such emergency jobs, but you may not have one. In that case try the method illustrated on this page.

Instead of the usual rosin core solder that is ideal for use with a soldering iron, you can smear the joint between the wires with a special paste which resembles automobile valve-grinding compound and is composed of finely ground solder mixed with a soldering flux.

When you heat the paste-covered joint with the flame from a match, the particles of solder melt, fuse together, and flow over the joint just as does regular solder applied with an iron in the usual way.

Of course the match flame will not supply sufficient heat to solder very heavy wire or sheet metal, but by using a gasoline blowtorch this soldering paste can be used on any job.

Long Loudspeaker Cords

WHILE there are many connections that should be kept as short as possible, there are practically no limits on the length of a loudspeaker cord. This means that you can run an extension cord to any part of the house with no appreciable falling off in volume. The reason is that the resistance in this part of the receiver circuit always amounts to several thousand ohms. The longest cord you could conceivably use would add only a few ohms to the total resistance. It is as though you were pumping a certain amount of water through a pipe many miles long. Adding or subtracting a few feet would not materially affect the flow of water.

Don't Be Fooled on Noises

A DOCTOR with a listening instrument called a stethoscope can tell you what is the matter with your heart. Similarly, you should learn how to tell what is wrong with your radio equip-



Soldering wires without an iron. The joint is covered with a paste containing pulverized solder. Then a match flame easily melts it.

ment by listening to the sounds from the loudspeaker. The doctor sometimes makes an erroneous diagnosis. The sound indications don't always work out as they should. The same thing can happen in radio.

A radio enthusiast complained the other day that there was a steady grinding noise in his receiver that disappeared when the antenna wire was disconnected. This would indicate interference from some form of electrical machinery operating in the immediate neighborhood. Upon investigation it was found, however, that there was no such interference.

The noise was caused by a corroded connection where the lead wire from the antenna was clamped to the binding post of the lightning arrester. This connection had not been touched for more than a year. In nearly all cases of this type the noise produced is intermittent and scratchy, but the corrosion in this instance was such that the noise sounded just like that produced by, for example, the brushes on the commutator of a fan motor.

In any radio testing for trouble, the first thought should be to find what portion of the equipment has become defective. In this case the cessation of all noise when the antenna was disconnected proved at once that nothing was wrong with the set itself.

When the Tuning Changes

IN MOST cases where the tuning of any given station suddenly changes you will find that the station actually has shifted its wave length, and you can be positive that this is the case if other stations come in at the points on the tuning control where you normally find them. The same reasoning applies to sudden weakness on the part of a particular station. If it suddenly drops to a low volume level, do not at once start tinkering with the set to find out what's wrong. First see if other stations come in with the accustomed volume. If so, then you may be sure that something is wrong in the broadcasting station.

Of course, if all the stations seem suddenly to have shifted their wave lengths, then the chances are that something has gone wrong with your set. Most likely the dial or drum of the tuning control has worked loose on the shaft and shifted slightly. You can check this condition by lifting the top of the cabinet, turning the control to the highest number, and noting if the condenser plates are fully engaged.

Old Power Tubes Distort

CONTRARY to the usual belief, the first sign of an exhausted power tube is not weak signals. Decreasing filament emission caused by many hours of use shows first in distortion when the volume control is turned too far. On weak signals, however, an old and practically exhausted power tube may give just as audible signals as a brand-new tube.

A B C's of Radio

THE watt is the unit used to measure the rate at which electric power is consumed, and the watt-hour to measure the power used within a definite time.

A current of one ampere at a pressure of one volt is one watt, and if the current flows for one hour one watt-hour of power has been consumed. In any circuit you can determine the power flowing in watts by multiplying the rate in amperes by the pressure in volts. Your electric meter reads in kilowatt hours, one kilowatt hour being one thousand watt-hours.

The Real Facts About Television

Institute of Standards Tests Reveal Its Shortcomings and Show How to Experiment in Newest Method of Communication

By ALFRED P. LANE

TELEVISION! A dozen times a day I'm asked to tell just when we will have television. And by television my friends mean a system whereby they can turn a knob as they do on their radio sets and see swiftly moving events, football games, yacht races, and so on recorded on a screen hung on the wall.

When I reply that I don't know, people seem astonished. For a couple of years, now, newspapers and public speakers have talked of television as an accomplished fact. It is really hard to convince the half-informed person that television, regardless of what tomorrow may bring, today is nothing more nor less than a laboratory plaything, a fertile field for experimentation. A field, by the way, that bids fair to produce a whole new crop of Edisons, for immortal fame and presumably a vast fortune awaits the fortunate individual who can take television as it is and make it what it ought to be.

SOMEDAY, perhaps in the not so distant future, we may have a television receiver that will do for your eyes what the broadcast receiver now does so well for your ears.

The principal difficulty is that television, which means the transmission of human sight, requires two-dimensional projection. Sound transmission is one dimensional. You can fuse the sound from all the instruments in an orchestra into a single complicated vibration so that it can be impressed on the carrier wave of a broadcasting station. Sight, on the other hand, is produced by the light vibrations reflected from countless numbers of points on the object seen. You could very easily convert the total amount of light reflected from the object into an electrical impulse, but there would be no way to reverse the operation and convert the electrical impulse into all the different light vibrations. It would be just the same as putting countless drops of different colored water into a common tank

and then trying to separate them again.

A real solution of two-dimensional radio projection would permit us to transmit a complete picture all at once. The next logical step would be three-dimensional projection, and if that problem ever is solved we should be able to transmit solid objects from place to place instantly!

parently see any object for at least a fortieth of a second after the light actually is turned off. This lagging nervous action makes possible one of our most popular forms of entertainment, the motion picture. Everyone knows that a motion picture is produced by throwing on the screen a continuous string of still pictures showing successive stages of the action so that the eye is fooled into seeing what appears to be actual motion.

Television is merely the same idea enormously complicated by the fact that in addition to projecting a series of pictures, the television apparatus, because of the one-dimensional transmission, must actually split up each picture into thousands of parts and transmit the parts one after the other, all within the time it takes for an ordinary moving picture projector to project one picture.

THAT this can be accomplished at all is truly one of the greatest scientific marvels of the age, and the fact that relatively simple apparatus is used makes the feat still more remarkable.

Both the television transmitter and the receiver operate on the same general principle. Of course, the transmitting equipment is relatively much more elaborate.

At present, experimental television programs are being sent out by station WGY in Schenectady, N. Y., and probably by the time this gets into print other broadcasting stations will have taken up the work.

Television is, in its present stage of development, of no particular interest to the man who is concerned only in fully perfected results from a commercially built television receiver. It does, however, present a wonderfully fascinating new field for the radio experimenter.

Assuming that you already own a high grade radio receiver, all the additional apparatus you need is shown in Fig. 4. This picture diagram has been reduced to the simplest possible form by the engineers of the Popular Science Institute of Standards radio laboratory.

This circuit is for use with a radio receiver that employs a



Fig. 2. Experimental television receiver set in the Popular Science Institute of Standards. Left, Fig. 2. The television disk with the pitch of the spiral and the distance between the bolts indicated.

So far, one-dimensional transmission is the limit of our knowledge. It solves, of course, the problem of sound transmission, and by an optical trick we have been able to make it serve for television in the experimental forms we know today.

This optical trick is based on a peculiarity of the human eye. The optical nerves in the eye do not respond instantaneously to changes in light. You ap-

TELEVISION is probably the most widely discussed of the new methods of communication.

Here is an article that explains just how far its development has advanced and tells of the difficulties that impede further progress. Readers interested in radio construction will find it of especial interest, for it details the apparatus needed to receive the television programs now being transmitted.

"Fame and fortune await the man who can take television as it is and make it what it ought to be!" says the author.

power tube such as the 171A or 910 in the last stage, and consequently is fitted with an output transformer or the equivalent in the form of a choke coil and bypass condenser.

With such an outfit, there is no direct current flowing in the loudspeaker windings. All that goes through the loudspeaker is the pulsating current that produces the signals.

In such a circuit, you must have an independent source of high voltage direct current to operate the neon tube that supplies the light for the television picture. Several forty-five-volt blocks of B-batteries or a very high grade B-eliminator can be used. A poor one will not do, because the hum it produces would be translated by the neon tube into a continuous flickering fatal to good results.

THE required voltage depends on the neon tube you use. Fig. 3 shows two possible types. With the one at left, a little tube that sells for a dollar or less, you can obtain a television picture only about five-eighths of an inch square. If you can possibly afford it, you will do well to buy a large neon tube specially designed for television. One is shown at the right in Fig. 3. The plates in this tube are large and flat so as to give the biggest possible image.

The other vital piece of equipment is a metal disk with holes drilled in it in a spiral formation as shown in Fig. 2. The diameter of the disk, the pitch of the spiral, the diameter of the small holes and their spacing depends on the equipment used in the broadcasting station and the size of the plates in the neon tube used in the radio receiver.

Of course, you need a motor to rotate the disk. It should be of the direct current type so that you can control the speed with a rheostat.

A universal type sewing machine motor with foot control probably could be successfully used, although this particular type of motor has not been tested for this purpose in the Popular Science Institute laboratory. It would depend on whether the rheostat was capable of exceedingly fine adjustment.

The only additional apparatus you need is a 1,000-ohm fixed resistance to be connected in one of the wires leading to the neon tube and a piece of ground glass. Of course, it will be necessary to make brackets to hold the motor, tube, and ground glass in approximately the positions shown in the diagram. A set-up of this type as used in the Popular Science Institute of Standards laboratory is shown in Fig. 1.

THE double pole double throw switch is included in the circuit so that you can instantly shift your radio receiver from the loudspeaker to the television equipment. This is needed because the experimental television programs are sent out only for short intervals and it is necessary to listen on the loudspeaker for the preliminary vocal announcements that precede each television program.

Assuming that you have a disk with spirally arranged holes suitable for the television broadcasting you want to receive, the first adjustment is to change the voltage applied to the neon tube until it is just on the verge of producing a pink glow. It is necessary, of course, to set the polarity of the battery so that the plate next to the disk is the one that glows. With the little tube shown in Fig. 3 this will be somewhere in the neighborhood of 120 volts; with the large tube, somewhere between 200 and 225 volts.

The next adjustment is to get the motor rotating at approximately the correct speed. At this writing WGY is transmitting at the rate of twenty-one pictures a second, which means that the disk must make twenty-one revolutions a second or 1,260 revolutions a minute. WGY is transmitting with scanning equipment that divides the image into twenty-four horizontal sections. That means that you need twenty-

four holes in the spiral. The spacing between the holes and the pitch of the spiral must be determined by the size of the plates in the neon tube. If they are one inch square, for instance, the holes are spaced an inch apart and the pitch of the spiral also is one inch. The diameter of each hole should theoretically be one twenty-fourth of an inch, but it is better to make them a trifle larger so that each hole, as it passes across the picture space, will sweep a path slightly overlapping the path of the previous hole. Great accuracy is required in the laying out and drilling of the holes. Each must be precisely where it ought to be within a very small limit of error, and each must be clean and free from burrs.

If the disk is perfectly drilled, you should be able to increase the voltage on the neon tube till it glows steadily and then, with the disk rotating, to observe a smooth, even band of light across the ground glass. If streaks appear, one or more of the holes is out of position.

Neither the number of holes in the spiral nor the number of pictures a second has been standardized. WGY is, as already mentioned, transmitting at the time this is written at the rate of twenty-one pictures a second with twenty-four holes in the spiral. Another station, which has announced television broadcasting for the near future, plans to transmit eleven pictures a second with a thirty-six-hole disk. Doubtless other stations will experiment with different combinations. You will note that each complete revolution of the disk allows each hole to sweep successive lines of light across the picture space on the ground glass until the whole area between the outer and inner ends of the spiral has been covered.

THESE disks with holes already drilled and also the neon tubes can be obtained from dealers in radio supplies.

The development which has made this form of television a possibility is the neon tube. This tube, unlike an ordinary electric light bulb, responds instantaneously to changes in current intensity. There is absolutely no lag in the action, so the amount of light given off by the bulb is always exactly proportional to the strength of the electric current flowing through it.

In the transmitting station, the neon tube is replaced by a photo-electric cell that also has an instantaneous response. The cell and the neon tube perform diametrically opposite functions. The tube produces light in proportion to the strength of current flowing through it, whereas the cell produces electric current changes in proportion to the amount of light that strikes it.

In the studio the light from the object to be transmitted is divided up by a scanning system equivalent to your disk. When the motor speed has been adjusted so that your disk is operating in exact synchronism with the scanning apparatus in the television studio, the photo-electric cell is receiving light impulses from exactly the same point on the subject being broadcast as is being illuminated by the light from your neon tube. Thus the light reflected from the subject is reproduced on your ground glass screen in shades of pink light.

The sharpness or definition is not very good. In fact you can't recognize a person's face unless it occupies nearly the whole picture space—and you are very familiar with the face.

The definition is actually worse than the coarsest screened newspaper illustration.

No satisfactory results are possible unless the signal is being received with considerable intensity, as from a local broadcasting station.

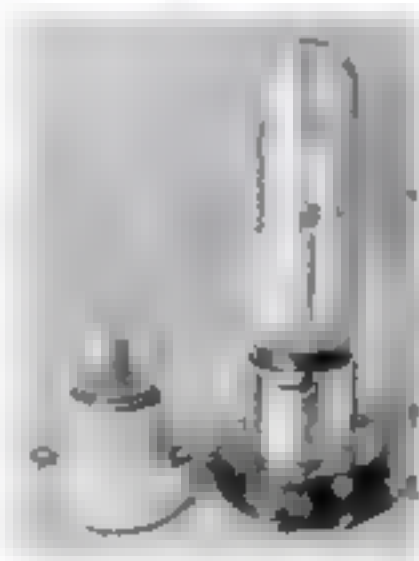


Fig. 3 Left—Small neon tube that can be used for television. Right—Large neon tube specially designed for television.

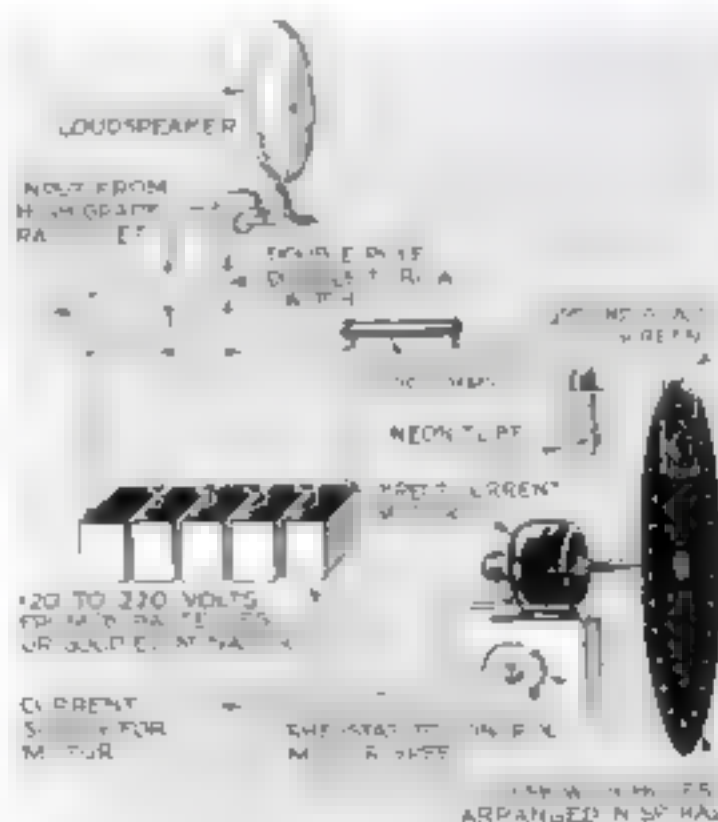


Fig. 4 Here is a picture diagram of an experimental television receiving circuit. The neon tube should be placed closer to the disk than it appears in the drawing.

Welcoming Inventors in the Navy

By
NORMAN C.
McLOUD

The indestructible, noncorrosive identification disk bearing an etched finger print for which J. H. Taylor received an award of \$700. It is of blended copper-nickel, iron and aluminum.



J. H. Taylor, civilian identification chief, inventor of three identification methods used by the Navy to slash the cost of records.

Cash Awards of \$50,000 Go to Ingenious Employees for New Ways to Increase Efficiency and Devices That Reduce Costs

BOOM! A wisp of blue smoke rises from the distant barge that lies at anchor in the river. An amphibian plane, poised on a rail above its deck, scoots forward, reaches the end, and skims into the air.

Here is the powder type of catapult that the U. S. Navy has just announced it will place on every ship that carries an airplane. And the man who first visioned it was no Navy officer, but a civilian employee.

In his spare moments Carl F. Jeanson, in the Navy's ordnance department, dreamed of a huge gun that could shoot a plane from a ship at sea. Gradually his ideas took definite shape. One night he sketched the plans. Next day he showed them to his superior. In a few hours he was explaining his invention to high Navy officials and engineers. And shortly the Navy paid him a handsome cash award and adopted his ingenious cannon catapult.

In every bureau of the Navy Department where civilians are employed—from the scientific laboratory to the Navy yards—there has been instituted a system of bonus awards up to \$1,000 to encourage inventions and the employ-

ees are allowed to retain all commercial and non-Governmental rights to their devices. They may obtain patents through the Judge Advocate General's office, saving the expense of lawyers.

Radio, navigation, aviation—these are but a few of the diverse fields in which Navy employees have demonstrated their inventive talent. From designing new metal filing cabinets to thinking up

schemes for checking deserters and feeding hungry "gobs," they have contributed many hundreds of machines and ideas that are saving the Navy Department thousands of dollars, and helping to make it the best equipped in the world.

USING a submarine's hull as a radio loop antenna was the novel plan that occurred to John A. Willoughby and Percival D. Lowell in the Naval Research Laboratory at Bellevue, D. C. They devised a radio set that made the undersea craft's shell a part of the "aerial." They received one of the highest awards and their device has been adopted for submarines by the navies of every country.

For an indestructible identification tag, used by the Navy during the European war, J. H. Taylor, civilian chief of the identification section in the Bureau of Navigation, received a \$700 award. He blended copper, nickel, iron, and aluminum into a noncorrosive disk carried on a noncorrosive wire around the neck. On it are indelibly etched the wearer's name and other data and the print of his right index finger. The bodies of drowned men



Plane being launched by cannon catapult invented by C. F. Jeanson, civilian in the Navy Ordnance Department. All plane carrying ships will have the device.

may be instantly identified, after many months, by the new tag, almost impervious to the elements.

The sonic depth finder—the precision instrument that surveys the bottom of the sea by timing sound echoes from it—was perfected by Dr. Harvey C. Hayes, a civilian in the Navy's research laboratory. His dream, of the ocean floor seen as clearly as if all the water were drained away, has come true! Two destroyers, cruising at twelve knots an hour, surveyed in a month a 34,000-square-mile area of the California coast that would have taken years to cover with the old method of weight and line sounding.

The Army submarine cable between the United States and Alaska had plagued and puzzled engineers for years with its frequent breaks off the rocky coast of Vancouver and northward. The Army cable ship, equipped with Dr. Hayes' depth finder, steamed over the route, and the cause of the breaks was discovered. Blindly, the cable had been laid over a veritable submarine mountain chain of sharp peaks. Now it was eased to a new, smooth path and the trouble ceased.

A MAP-DRAWING machine that has enabled the Navy to treble its annual output of navigation charts was the invention of John H. Larrabee, senior engineer, and T. Peter Lampe, cartographic en-



Lieutenant J. B. Williams explaining the new salvage valve on the new submarine V-4.

whole roomful of receiving sets to a single antenna without their "howls" disturbing one another.

The first high-frequency transmitter used by the Army and Navy won Raymond B. Meyer, of the research laboratory, a \$250 award. Two other laboratory workers, Raymond B. Owens and Robert H. Warrall, devised a "crystal controlled calibrator" to measure high-frequency radio waves, and to standardise other

meters, with an accuracy of one part in 50,000—a precision that far exceeded that of the best laboratories at the time. And any radio fan would be happy to own the marvelous sharp-tuning set that brought an award to Edwin L. Powell. His receiver can be tuned so closely that powerful stations of almost identical wave do not interfere in the least.

To win a Navy award, it is not always necessary to invent a new mechanical device. Any plan to make some corner of the Navy Department more efficient, perhaps a change in routine suggested to a worker by his own experience, is equally eligible for a cash prize.

NOT long ago, John W. Kean, civilian chief of passenger transportation for the Navy, tried a new plan to feed sailors he was transferring from Chicago to Seattle. Dining cars hitched to special trains at meal hours had proved unsatisfactory. Kean hitched a "kitchen car" to the train for the entire journey. The cost was half that of dining car or station restaurant methods. The Navy paid Kean \$500 and with his plan has already saved \$100,000.

A one-finger system of identification, devised by J. H. Taylor, inventor of the indestructible tag already mentioned, won him another award, this time of \$500, and saved the Navy thousands. Its effectiveness may be judged from a recent incident:

At the recruiting office at Denver a man applied for enlistment with the prospect of being sent to the Great Lakes Training Camp at Chicago—a trip that costs more than \$30. He yielded his fingerprint and the officer compared it with 300 cards in his file—the prints of notorious "professional repeaters" who joined the Navy only to receive transportation to some distant point and then deserted.

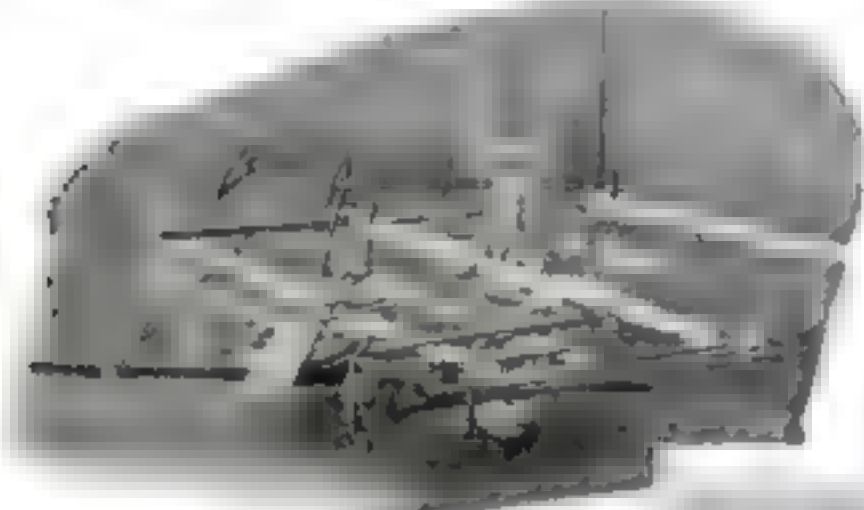
"Your name?" asked the officer. "Peter Smith," replied the applicant.

"Not this time," came the retort. "You were Richard Roe when you disappeared from Norfolk July 27, and you're wanted for desertion. Your print gives you away." Ten minutes later Smith, or Roe, was traveling at Government expense—but not to Chicago.

Taylor won also a \$500 bonus for his scheme of recording a vast number of fingerprints on photographic paper instead of film, slashing the cost from fifteen cents apiece to one and one third cents, and invented an infallible system to identify service men by classified records of the condition of their teeth.

FIVE women—Mrs. M. E. Smith, Miss Emily Long, Miss Fanny Willson, Miss Agnes Gallagher, and Miss Alma Davidson—have won awards for improvements in clerical work and office routine.

Is the award system worth while? Since the plan was put in effect in 1910, the Navy has distributed \$50,000 in prizes and it considers every cent well spent. "The Navy takes pride in the resourcefulness of its civilian personnel," I was told by Secretary Wilbur, "and the award system has proved a stimulus from which the establishment has reaped benefits of the utmost importance."



The pantogriper, more accurate than its operator, which triples the Hydrographic Office map output.

gineer, in the Navy's Hydrographic Office. Recently their device turned out a perfect chart of Port Matanzas, Cuba, in just fourteen days.

Formerly all maps were engraved by hand on the copper printing plates, and twenty a year was the best the Hydrographic Office's overworked staff could do. Now the pantogriper, a machine more infallible than the hand that guides it, transfers lines and figures from an original sketch on glass to the copper plate.

Radio, a favorite field for the Navy's inventors, has inspired everything from a new type of radio compass to a novel scheme of using many receiving sets from one aerial. Warren B. Burgess, of the research laboratory, made an improved radio compass that is in use in every United States installation, enabling ships along the coast to obtain bearings with unprecedented accuracy. A \$1,000 award went to two of his fellow workers, A. Hoyt Taylor and L. C. Young. All Navy combat vessels carry their tube to hook a



Albert Lenky (left) and James Reed of the Charlestown Navy Yard with links of their demountable chain, for which the Navy awarded them \$500.

First Woman Flies Overseas

Amelia Earhart Proves Value in Ocean Flight of Multiple-Engined Seaplane

THE flight of the *Friendship* is intended to point the way toward the use of the seaplane instead of the land plane as a means of flying across oceans and multi-oceanic routes. It will help toward more comfortable flying, when women demand planes not only comfortable but luxurious in a well-constructed.

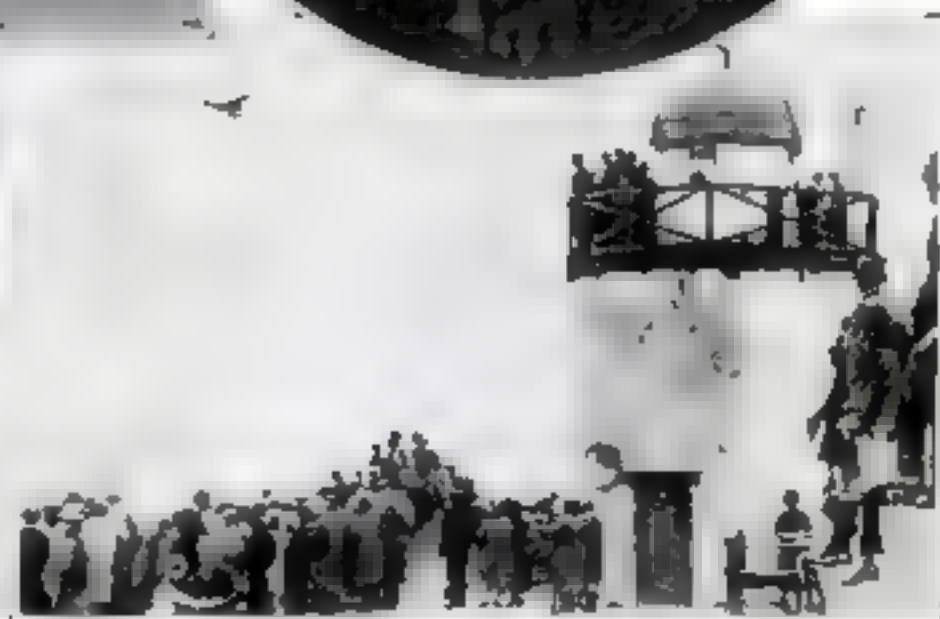
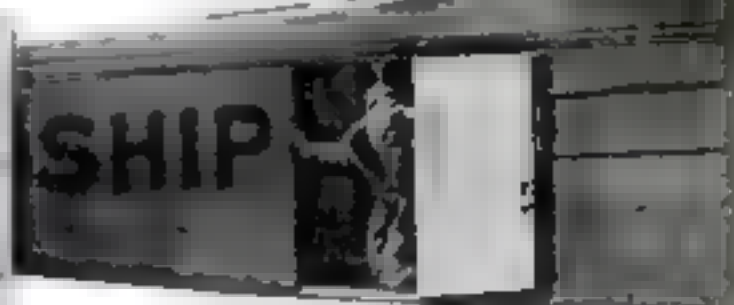
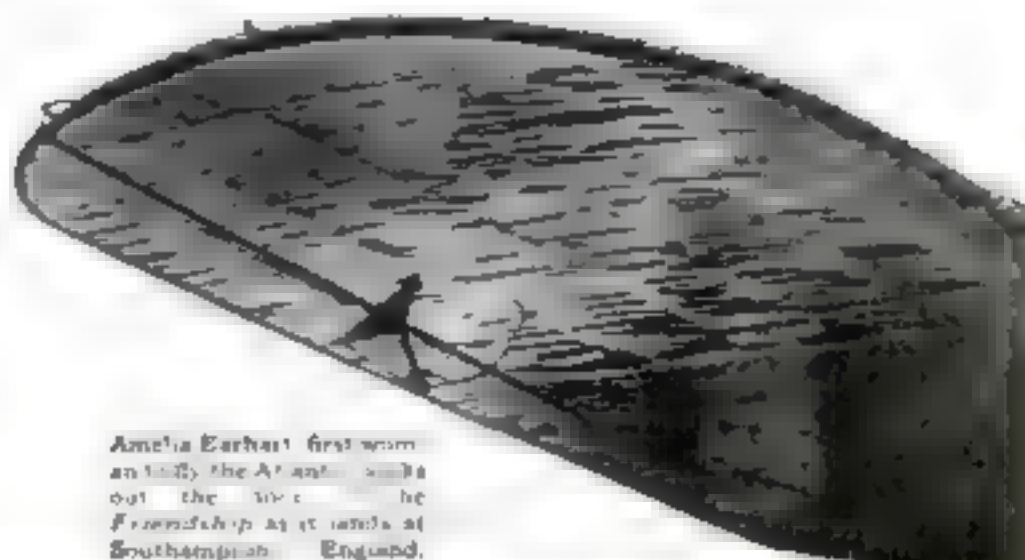
These statements of Miss Amelia Earhart, the first woman to fly across the Atlantic, expressed the true importance of her recent flight with Walter Hartz, pilot, and Lee Gordon, co-pilot, from Trepassey Bay, Newfoundland, to Burry Port, Wales. In less than twenty-two hours they flew 2,000 miles, much of the way through fog.

Their machine was a three-motored Fokker seaplane, originally designed for Commander Richard E. Byrd's Arctic expedition.

It was the first crossing in a plane equipped with ponderous machinery that had forced down.

During a journey which nearly had cost the lives of three women, Miss Earhart has placed herself to make the controls, but fog, and the strain and necessity of flying by instruments were perils that added to the danger.

Amelia Earhart first woman
across the Atlantic, with
out the first time, the
Friendship at it lands at
Southampton, England.



The *Friendship* starting from Burry Port for Southampton. Above: Amelia Earhart, 30-year-old aviatrix, settlement worker and business woman, who dared flight that had cost three women their lives. She says the exploit proves the superior value of multiple-engined planes.

The Fokker seaplane *Friendship* (in the air, upper left) as it was arriving at Burry Port, South Wales. Above: Southampton's welcome to the *Friendship* flies. Miss Earhart is shown protected by police from the throng that almost overwhelmed her in its admiration for her gallant flight.



The four Super Napier flying boats, which recently flew 23,000 miles from England to Australia, are shown here en route at the Singapore Air Base. Group Captain H. M. Cane-Brown-Cane, of the Royal Air Force, commanded them.

Gains in Conquest of the Air

Rome-Brazil Nonstop Flight Sets New Air Distance Mark;

Plane Refuels 5,000 Feet up to Seek Endurance Record;

Soundproof Cabins and Most Gigantic Motor Are Announced

Italians Fly 4,400 Miles

BLAZING a 4,400-mile trail from Rome across Africa and the South Atlantic to Brazil, the Italian flyers Capt. Arturo Ferrarin and Major Carlo P. Delprete have just accomplished the longest nonstop flight in history. Their hop, ending on the Brazilian coast near Natal, eclipsed by 300 miles the record distance flight of Chamberlin and Levine from New York to Eisleben, Germany, made last year.

When the silver-gray Savon-Marchetti plane, the Italian tricolor on its rudder, descended it had been fifty-two hours in the air. After taking off at Rome, the aviators had skimmed over the Mediterranean Sea and the Straits of Gibraltar, down the African coast, and then straight across the south Atlantic on the last and most dangerous leg of their flight. Radio messages from the plane speeding, sometimes as fast as 135 miles an hour with a favoring wind, told of its progress toward the South American coast. At its goal, a reserve supply of gasoline sufficient for eight hours' flight remained; only fog forced down the aviators, thwarting their original plan to continue down the Brazilian coast without stopping.

In this same single-motored plane, Ferrarin and Delprete had not long before set a world's record for sustained flight. Both men are members of the Royal Italian Air Force. Capt. Ferrarin, who won a silver medal and two war crosses for his air exploits in the World War, made the first air journey between Italy

and Japan in 1920, and in 1926 was a member of the racing team that defeated the United States in the Schneider Trophy race at Norfolk. Major Delprete already had one Atlantic flight to his credit; he accompanied Commander de Pinedo, as co-pilot, on the latter's four-continent air trip early last year.

Many Seek Endurance Record

FOR a while it looked as if the fifty-three-and-a-half-hour mark set not long ago by George W. Haldeman and Eddie Stinson had clinched for America the world's airplane endurance record. But it was not long to stand. Two Italians, Capt. Arturo Ferrarin and Major Carlo P. Delprete, whose latest ocean exploit is described above, flew fifty-eight and a half hours to a new record.

Then a pair of Belgian flyers, Adj. Louis Crocq and Sergt.-Pilot Victor Broenen, stayed aloft over Brussels more than sixty hours, but refueled in the air! In the novel experiment they repeatedly took on fuel while 5,000 feet up from another plane, overhead. Connection was made by a flexible tube sixty feet long, for six minutes the two planes flew in perfect coordination.

Before the Federation Aeronautique could decide which mark to recognize as official, a pair of Germans settled the question. Flying their Junkers plane for sixty-five hours and thirty-one minutes, the other day, Cornelius Ristox and his companion Zimmermann clinched for themselves the world's endurance mark.

Deadening a Plane's Roar

THE U. S. Bureau of Standards is seeking to make flying less of a strain on the eardrums. So far the best success has been obtained, according to Dr. J. H. Dellinger, Bureau physicist, by use of cabins with four-inch soundproof walls, faced with thin aluminum sheets, lined first with a veneer of wood and then stuffed with "dry-airo"—a lightweight cottonlike substance which is grown on South American trees.

Mufflers of the motors have not been favored, since they cut the power and increase fire hazard, but experts are trying to design less noisy propellers. At present, it is said, the propeller makes nearly as much noise as the motor itself.

New Aero Motor Is Biggest

SAID to be the largest type of aero engine now in use, and differing from all others in design, a new Curtiss air-cooled motor recently tested in a standard two-passenger observation plane develops 600 horsepower from its twelve cylinders, set in two rows of six. In spite of its great power, the motor weighs but 900 pounds.

Nations Race to Lead in Air

GERMANY leads the world today in commercial aviation, with the United States so close a second that it is likely to take the lead in another year. France, Italy, and Great Britain trail in the order named. (Continued on page 157)



Navy's Sikorsky Amphibian

The take-off at Curtiss Field, New York, for the first trip of Uncle Sam's plane that is almost a duplicate of the Dawn, in which M. A. F. Gravena was lost attempting a transoceanic flight.



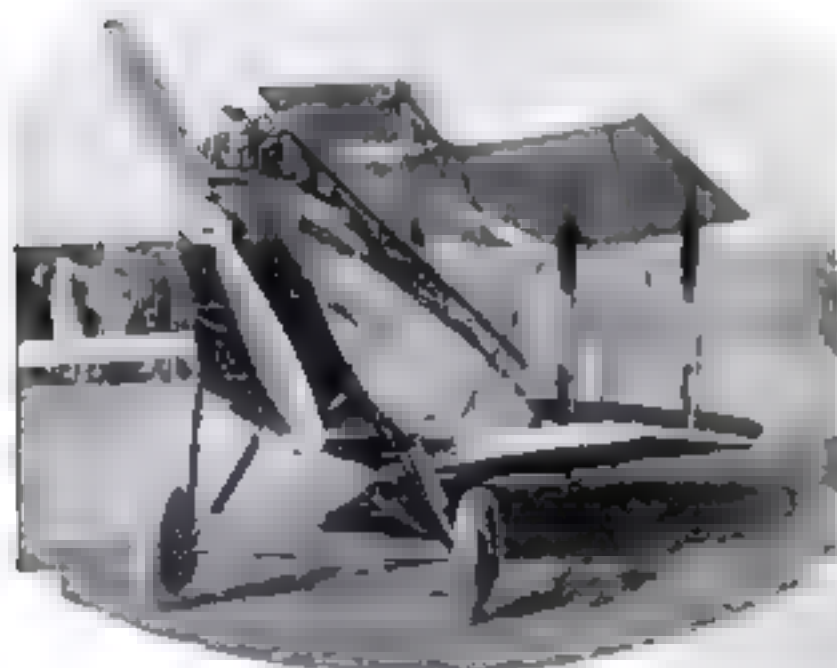
Plane Ready for Catapult Launching

This powerful machine, capable of landing on or taking off from either land or water, was built in the American Navy Yard at Philadelphia. It is shown on a catapult stand ready for flight. Intended for service with the carrier Langley, it is now being tested at San Diego.



Junkers for New Nonstop Paris-Berlin Air Service

This 16-passenger monoplane with three 450-horsepower motors and exhaust pipes to carry the fumes beyond the cabin is named Hermann Goering in honor of the Bremen's famous pilot. It is one of the most luxurious planes of the Luft Hansa (Air League) — a merger of several early German air transport companies.



Safety Plane Flies in U. S.

This folding plane is being used at Curtiss Field, N. Y., to demonstrate the operation of Handley Page slot-wing, described in detail in this magazine last February. They are said to prevent spins and crashes.

Auto-Giro Crashes

Something went wrong when Don Juan de la Cierva recently flew his famous auto-giro, a plane with "windmill" wings which can rise and descend in restricted space. The flyer survived the 30-foot fall, which occurred at an English air pageant, but the machine was damaged.



Weather Man Flies for Data

A. A. Stott (right), chief aerographer for the Navy, who goes aloft daily, is shown here with his assistant Lieut. W. K. Berner, and the aerograph that he takes up.



Inventions for Home Makers



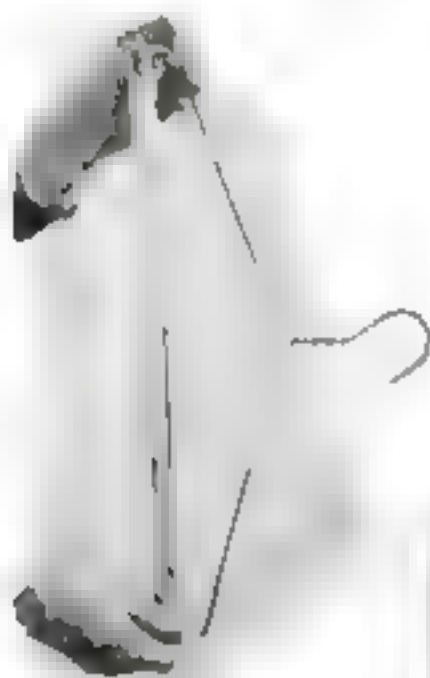
You can mix a milk shaker beat eggs, or whip cream in a few seconds with a new water power mixer. It attaches to any standard faucet. And at the top of the device is a socket for a setting a stop—wherever you like. It will put a green cage on knives.



Seventy-five feet of living space right in your kitchen. That's what the new kitchen is for a new kitchen design. It is a kitchen that is built in a room. It can be moved at any time. It is a kitchen that is built in a room. It can be moved at any time. It is a kitchen that is built in a room. It can be moved at any time.



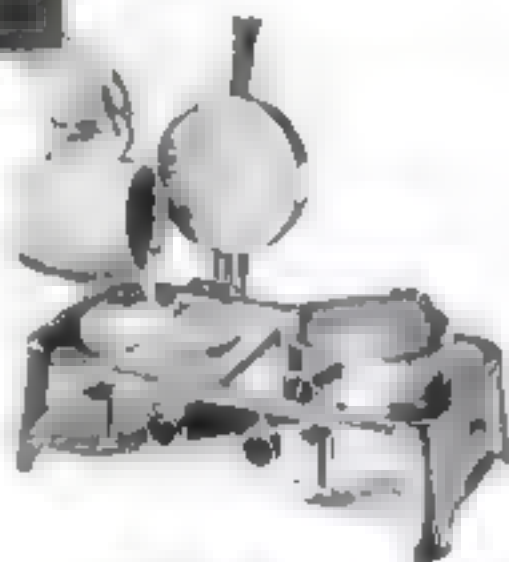
This handy tightener quick ties the necktie. It is a device that is built in a room. It can be moved at any time. It is a kitchen that is built in a room. It can be moved at any time.



Merely by passing clothes on this new type of hanger you protect them from moths. The hanger is built in a room. It can be moved at any time. It is a kitchen that is built in a room. It can be moved at any time.



With an adjustable sleeve that fits the vacuum cleaner, this new household sprayer hooks on your machine in a second to apply lacquer or paint to furniture. In 30 many other household jobs by means of the machine's blower. It will spray wood stains on new sides, door out—on fast every thing up to the consistency of light motor oil. A thumb trigger is used to control the spray.

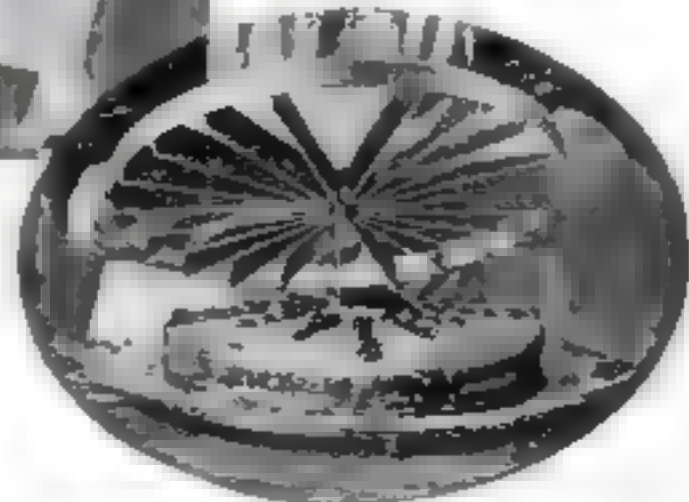


Now the waffle maker is a waffle maker. A waffle maker is a device that is built in a room. It can be moved at any time. It is a kitchen that is built in a room. It can be moved at any time.

No argument about who's getting the biggest piece of cake when the new many-sliced cake is shown. It is a cake that is built in a room. It can be moved at any time. It is a kitchen that is built in a room. It can be moved at any time.



Within the hollow shell of this nickel plate, using the huge eleven other useful household utensils, including a scoop, biscuit cutter, and potato masher. In the summer time, cracked ice placed inside the roller keeps the dough cool and easy to handle.

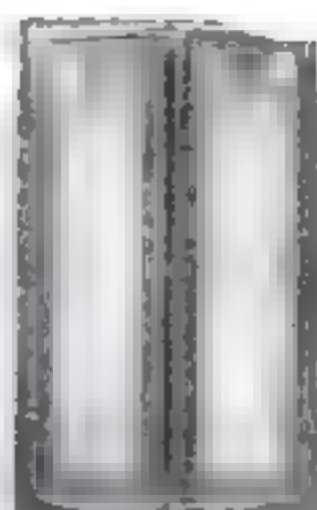




In this combination whisk broom and shoe cleaning set, a felt pad for shoe polishing is part of the handy case containing the brush. The compact kit is especially suitable for travelers.



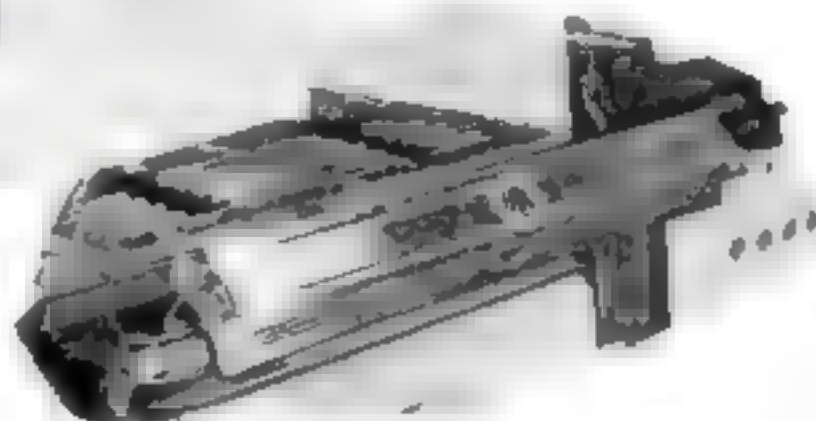
When the meal is over, this handy steel kitchen or breakfast nook table folds into the wall, out of the way. And in a miniature wall cabinet behind it is room for more than fifty breakfast plates of assorted sizes. A sliding ironing board, concealed below the cabinet, may be pulled out for use in a moment.



In five minutes a wrinkled tie can be restored in this convenient electric presser. An aluminum tongue is placed in the tie, which is moistened and placed between electrically heated felt pads.



Here is a special miniature ironing board for use in pressing neckties. One side of the board is faced with tin; the other is faced with felt, to prevent shine. An ordinary iron is used with the device.



Gas cocks on the kitchen range are made foolproof by a new cover that protects them from being turned on accidentally, or by catching in your clothing. It also prevents children from playing with danger. When you want to light the gas, a concealed latch at the left releases the cover and it swings back out of the way.



A shoe-shining cabinet in the wall is the latest household novelty. It contains a hinged foot rest that can be let down for instant use, as well as ample shelf room for polish, cloths, and brushes. Closed, it becomes a white panel set into the wall, which conceals its real purpose.



Even the spring folds up in a new collapsible bed for cottage or camp. A special hand lever, operated by a gentle one-pound pressure, exerts a 1,000-pound pull to stretch the coiled spring tent and lock it in position. The bed can be set up or folded for storage in a minute.

Anywhere you press it against the wall, the novel ash tray, pictured below, sticks fast until you are ready to remove it. A rubber suction cup holds it firmly in place. With such a receptacle available in the house or car, there is no excuse for dropping cigar or cigarette ashes onto the rugs and furnishings.



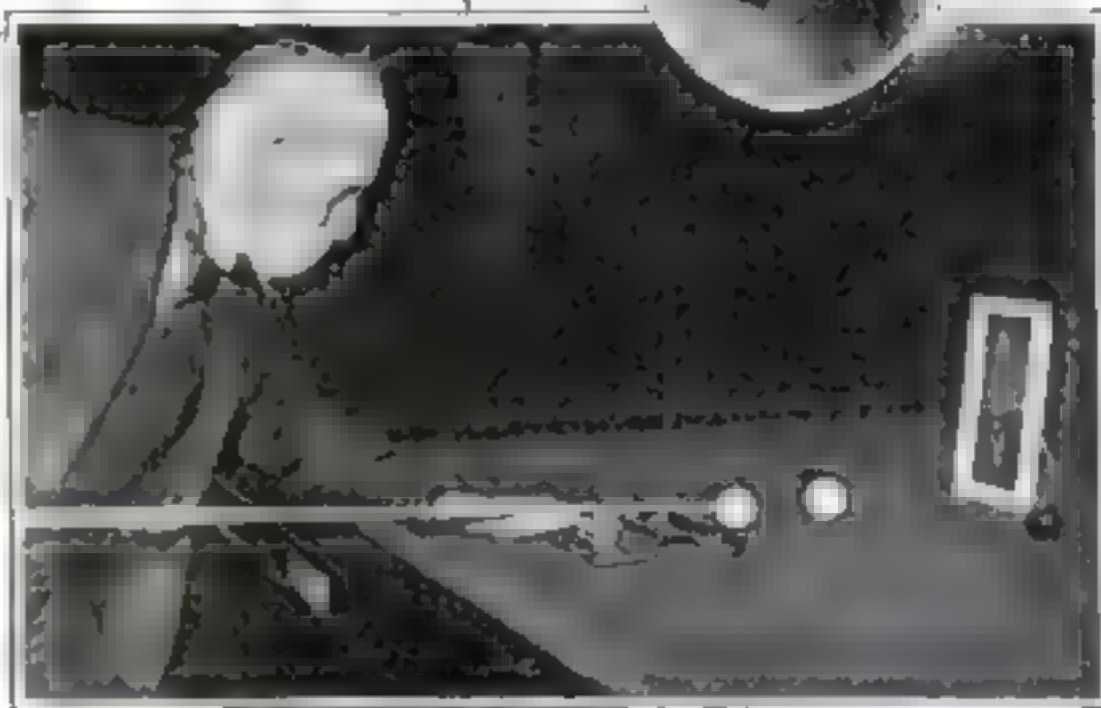
Always a Place for New Ideas



Now, when he takes his medicine, he doesn't have to hunt for a spoon. Ferdinand Philippon, of New York City, has invented this metal bottle cap that has its own spoon attached. "One teaspoonful after meals" is easy, because bottle and measuring spoon never are separated.



Faster than knife or shears is this novel device for cutting clippings from newspapers or magazines. Two sharp knife edges joined in the form of a spring resembling an oversized hairpin can be separated to any cutting width, so that a whole column may be clipped from a paper at a single stroke. Blades are adjusted by a small screw and stay put until they're fixed.

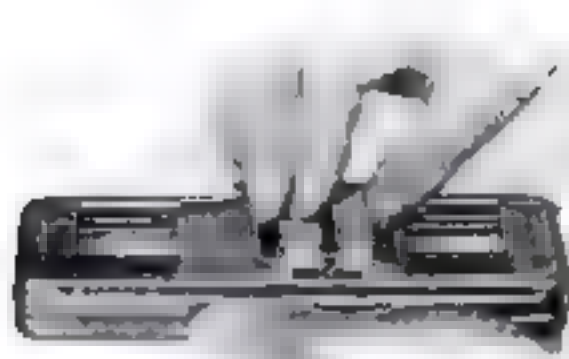


Even the clever hand of a wife has to struggle with a game. And a difficult job even for a man is made easier by a new device. It is a flashlight that can be held in the hand and used to illuminate any work. When the light is turned on, the flashlight is held in the hand and the light is directed at the work. It is a new idea in lighting.

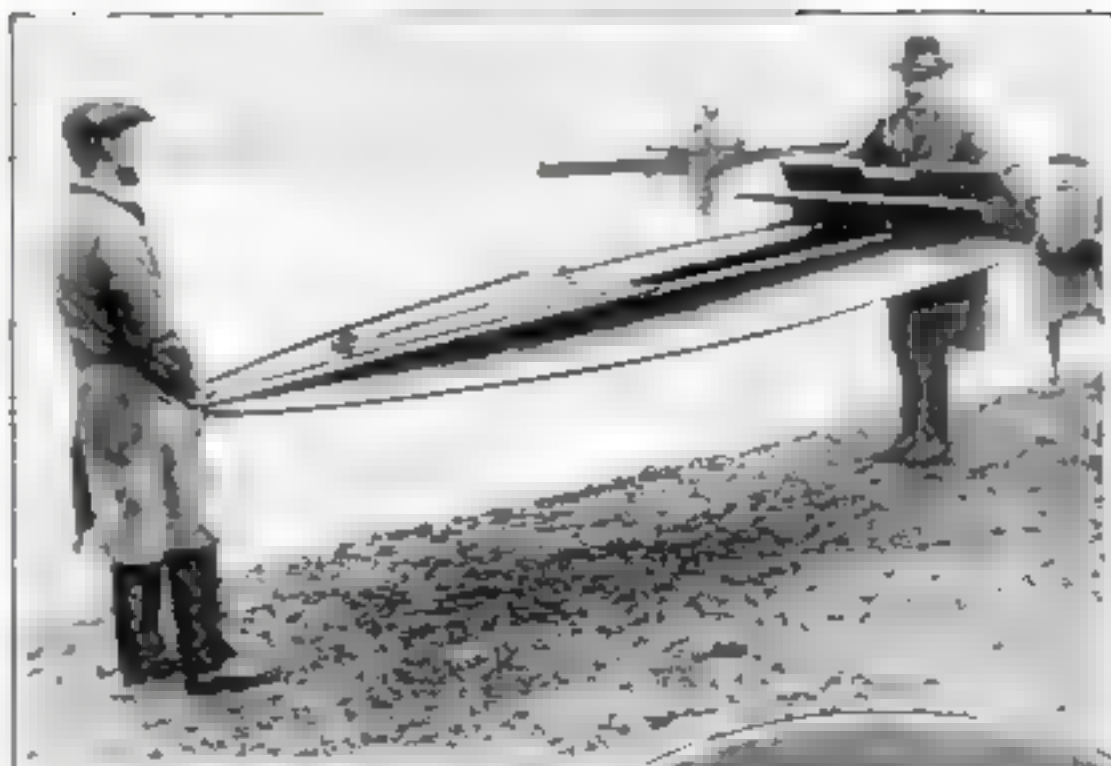
Why clamp a flashlight on the fingers? The answer is that it leaves both hands free yet can be played in any direction. And that is the idea of the ingenious invention shown at the right. It is used as an all-purpose trouble lamp.



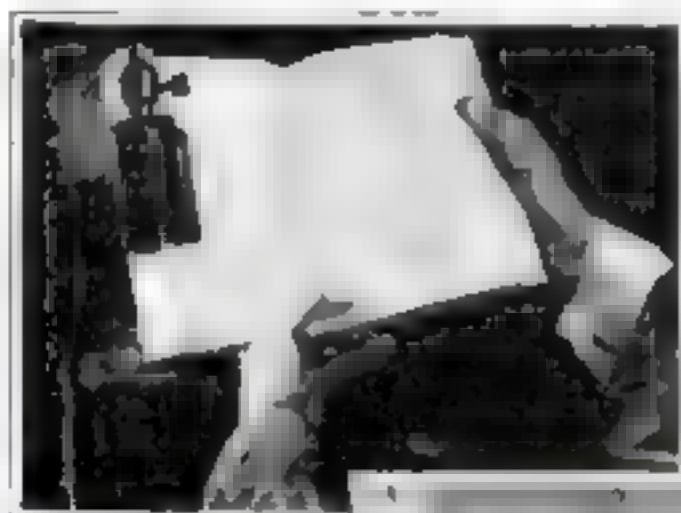
Here's one the wife may appreciate—a new type of ash tray with a glass dish that may be removed for washing. When in use the dish is held in place by a snap spring. —At the left is a new kind of shovel, shaped like an ice cream spoon and scientifically designed to do the hardest digging with the least effort. Pointed tip and reinforced foot plate are said to give high efficiency. It represents fifty years of research, according to the company producing it.



This safety razor blade sharpener combines both hone and hone. Both are set in the metal frame. The blade inserts in a sliding carrier, passes first over hone surface (right), then over polish surface (left) for a fine edge.

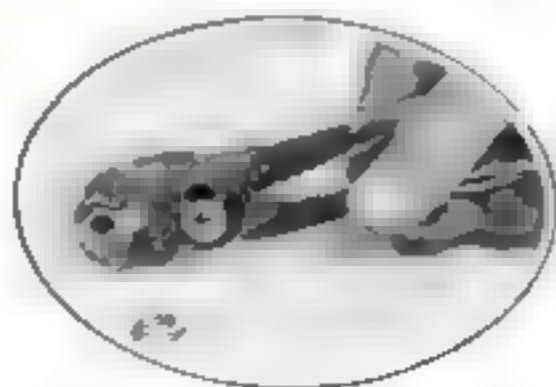


Light and rapid transport is carried in topmost automobile boat on the river. The boat is a light and fast motor launch, built by the local government. It is made of bamboo and is so light that it can be carried on a shoulder pole. The boat is an eight-horsepower motor launch, built at the speed of light in the local boat building industry in recent years on the Yangtze River.

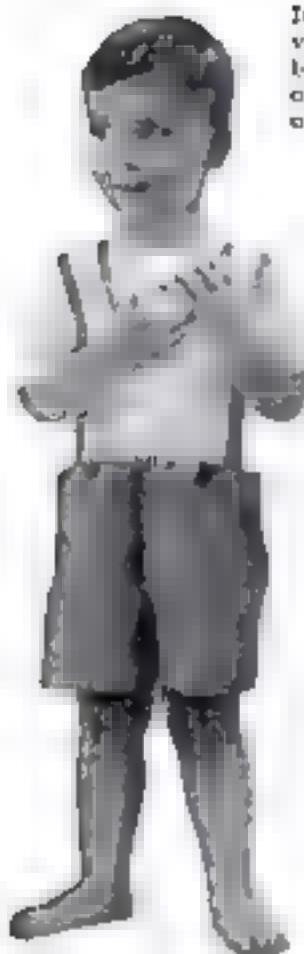


To provide for the lighting of the desk, a small lamp is attached to the desk. The lamp is a small, portable lamp, built by the local government. It is made of bamboo and is so light that it can be carried on a shoulder pole. The lamp is an eight-horsepower motor launch, built at the speed of light in the local boat building industry in recent years on the Yangtze River.

Invented for musicians who travel the world, this violin above offers two pickup ages. Musicians carrying board its muted tones will not disturb others in hotel or apartment house. Then it can be taken apart with out damage and reassembled in half a minute's time.



With jaws that fit the corners of hexagonal nuts, this combination of wrench and pliers is designed to grip any nut firmly without slipping and without chewing the corners. It is a handy tool for mechanics to carry.



This healthy young man is enjoying his daily sun bath, clad in an open work suit designed by the U. S. Forest of Home Economics to admit the beneficial ultra-violet rays contained in sunlight.



Shaving by spotlight is the latest idea for speeding up the daily chore. Light from an electric lamp attached behind the mirror is focused on the face by a lens inserted in the lower part of the mirror. A ball and socket joint makes it possible for the shaver to direct the light beam to any portion of the face desired.

Close-Ups of Unusual Men



Despite his physics laboratory Dr. A. A. Martin, one of the best known of the long list of high school teachers who go into the great world of science, here sits with his water glass.



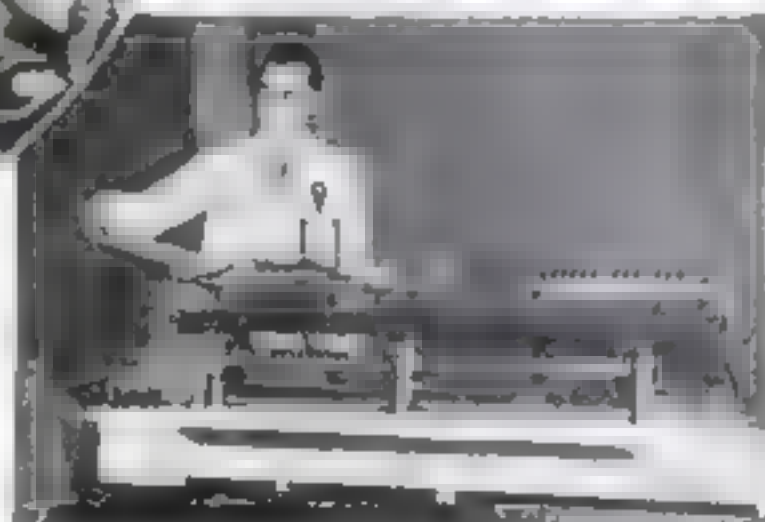
Mrs. Dave Dingler of Maine, president of the Maine State Federation of Women's Clubs, is a well-known and popular figure in her community.



By inventing a new single-strand type of cable for submarine mines, Bergt Paul R. Nelson of the Coast Guard will save Uncle Sam a million dollars in ten years.



He has, and has, invented. W. R. Nelson is a member of the University of Pittsburgh, and is now working at the Carnegie Observatory.



One man does the work of ten with the bottle-sealing machine invented by Perry W. LeDuc, chemist in the U. S. Department of Agriculture, thereby saving \$13,000 a year.



Champion slate splitter of America is the title claimed by Dell Williams, of Bangor, Maine. In a recent contest he split forty-eight perfect sheets of slate from a one-inch block. His tools—mallet, chisel, and bristle pipe.



Capt. Charles J. Van Amburgh (center) is firearms expert for Massachusetts, the only state that employs an authority to solve criminal cases by the scientific examination of identifying marks on bullets and weapons.



This motor car is rushing into a lion at a speed of 30 miles an hour without suffering damage. The protector on the bumper is new. Go down again in case it suffers by a second process which gives extreme durability and toughness.

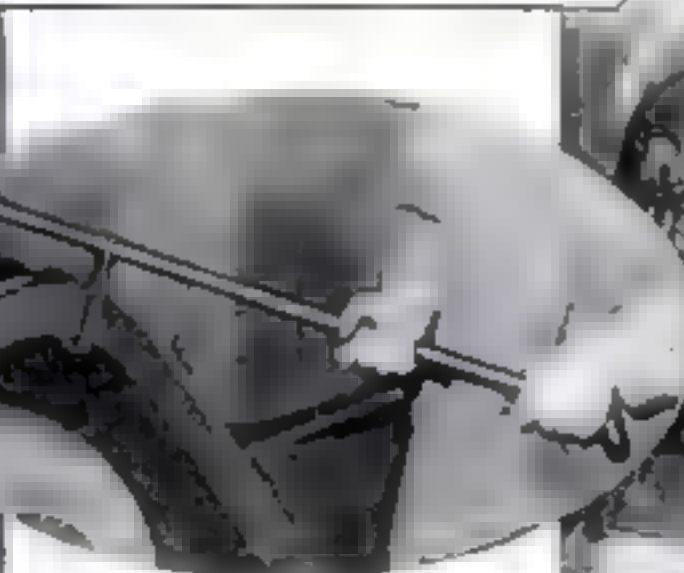


Skidding is avoided by this wide tread wheel with deep grooves which fill with the ground or grass with a force of 500 pounds. The wheel is used in a way which the driver may find it apply it by throwing a lever.

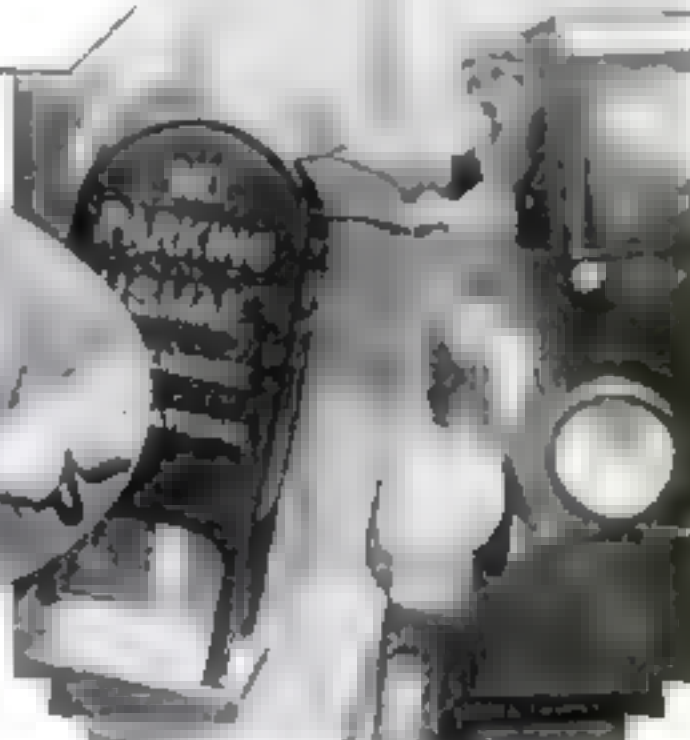
Making It Easier for the Motorist



By means of this compact device just invented for new Ford cars, both starter and choke can be operated with one finger. The attachment, when in place, is only eight inches from the wheel and is easily installed.



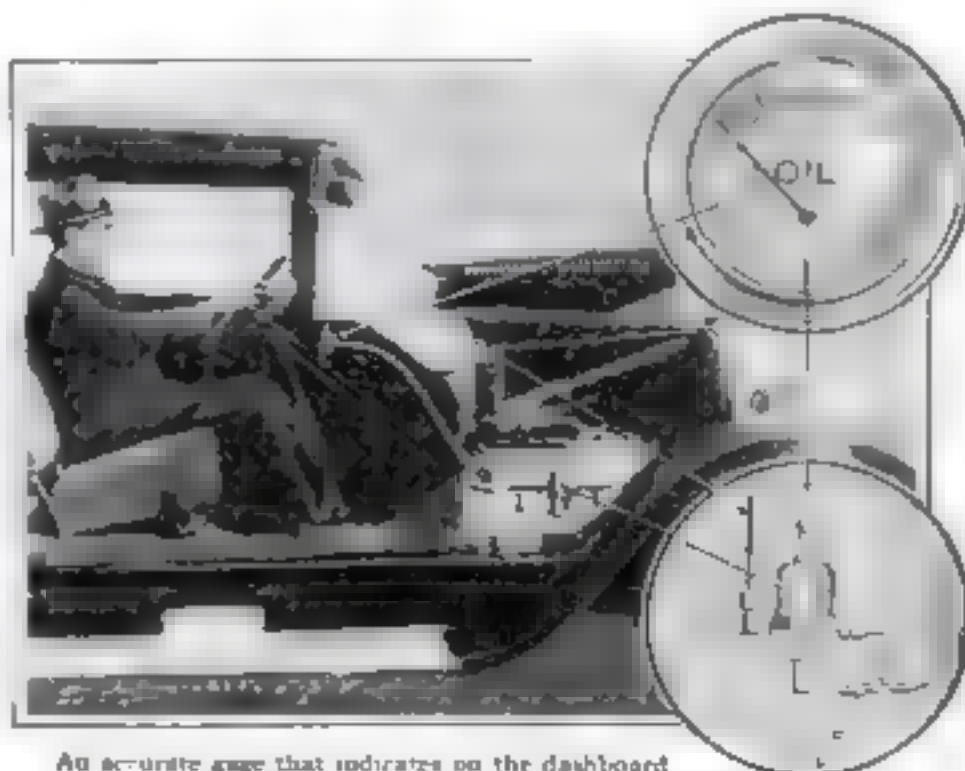
With this handy tool a sliding hook grasps the bent edge of a fender and leverage pulls it straight. A leather pad prevents marring the paint. A hook on the other end of the device straightens bent fender flanges.



This new "automotive mail box" is designed to prevent traffic delays caused by drivers who park while they mail letters. It is being tried successfully by the Baltimore Post Office. A lever opens the letter slot.



A new "observation car" automobile body enables rear-seat passengers to view the country as from a railroad observation car and, incidentally, discourages "back seat driving." The door is conveniently placed at the back and folding steps are provided. The car is an English invention.



An accurate gauge that indicates on the dashboard of your car the exact condition of your oil puts an end to the necessity of renewing oil in the crank case on the basis of mileage. The photograph and the drawings show how the gauge is connected with the crank case.

The Month's March in Science

Two Victories Over Pests

WEAPONS and inventions of modern warfare have been brought into action recently in two decisive victories on land and sea over destructive pests, age-old enemies of man.

After years of experimenting, Uncle Sam's Chemical Warfare Service has at last developed a successful defense against ship borers, the submarine destroyers which undermine wharves and which, it is said, have destroyed more wooden ships than all the naval battles in history. The new weapon is a poisonous chemical solution, a derivative of the high explosive Lewntite. Applied to the pilings of wharves, it destroys the armies of sea worms.

In Palestine this summer, an invading host of locusts was driven back by flame guns and poison sprays. Since ancient times these insects have periodically ravaged the Palestine crops, bringing famine. This year scientists and military men rushed mobile field units to meet the enemy. First powerful portable lamps were used to attract the insects into traps. Then the flame guns and poison sprays were brought into action, slaying the locusts and their unhatched eggs.

Often it has been said that insects are man's worst enemies. It is requiring deadly inventions of human warfare to defeat them.

New Gains by Medicine

THE health of the world is improving, and the gain is most marked in America and Europe.

Such is the encouraging word of Dr. Hugh S. Cummings, Surgeon General of the United States, after attending the 1928 meeting of the Health Organization of the League of Nations at Geneva. Among the reasons, he says, are closer international cooperation among health authorities, improved sanitary conditions, the spreading of health information with responding public interest, and the establishment of a world-wide intelligence service to warn against plagues and safeguard against the spread of epidemics.

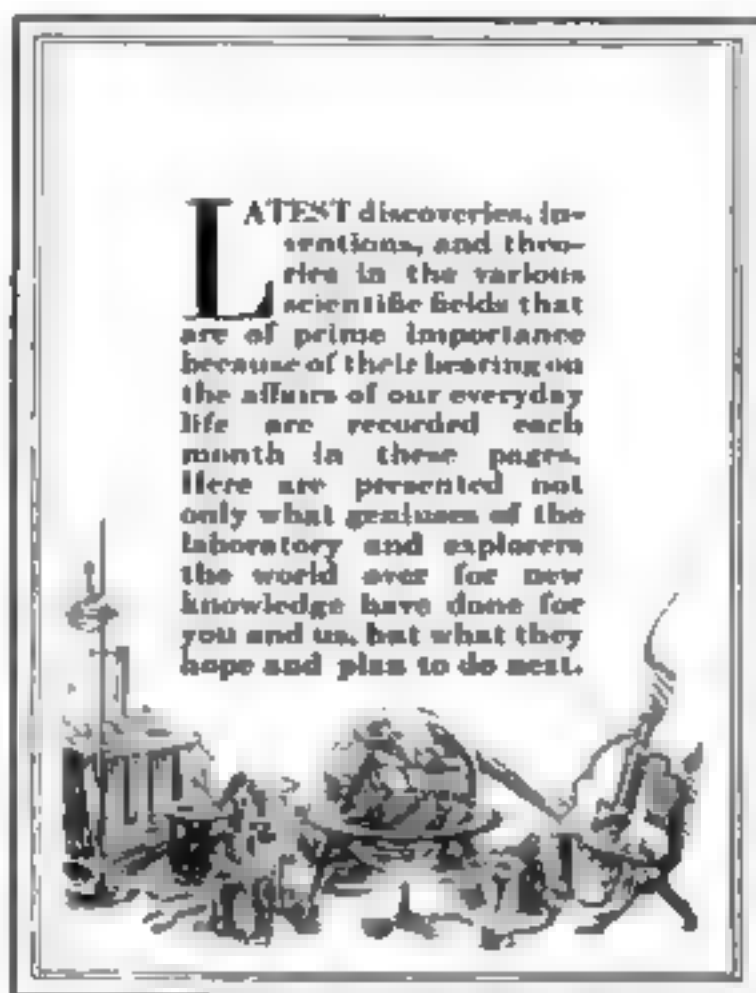
Meanwhile physicians and surgeons are attacking disease more relentlessly than ever. The newest phase of this attack, says the distinguished surgeon, Dr. William J. Mayo, is the closer study of the chemistry of the human body. In the past he says, "medicine has attempted to cure or ameliorate disease by combating its gross manifestations." Now, however, medical men are turning attention to chemical changes within the body that allow disease to gain foothold. Thus, he believes, opens a new line of attack on disease—cancer in particular.

It remained for Dr. Samuel W. Parr, professor of applied chemistry at the University of Illinois and president of the American Chemical Society, to point out recently that the prevalence of the com-

mon cold may be due to poison in soft coal smoke. More than four hundred billion cubic feet of sulphur dioxide gas, he said, is poured yearly from the nation's chimneys. Dr. Parr urges organized research to determine the effects on public health.

Marconi Has New Project

WHENEVER Marconi sails on one of his cruises in the yacht *Eletra*, the world looks for some advance in wireless.



LATEST discoveries, inventions, and theories in the various scientific fields that are of prime importance because of their bearing on the affairs of our everyday life are recorded each month in these pages. Here are presented not only what geniuses of the laboratory and explorers the world over for new knowledge have done for you and us, but what they hope and plan to do next.

It was not disappointed when, returning recently to London after his latest voyage, he announced that he was working out an improved method of beam transmission which will widen the range of world communication.

At present a beam of radio waves can be focused only in one prearranged direction. Marconi proposes now to arrange the apparatus so that the beam can be shifted by the operator, like a searchlight, to any part of the world.

"As beam stations are fixed at present," he said, "America cannot be turned on to Japan, nor India to Russia or the North Pole. Where there is a revolving beam, if you want to transmit it to a certain country, you merely direct the beam toward that country."

One of the mysterious freaks of radio—that is, the occasional ability of metal objects to give forth broadcast music without the presence of a receiver—has been the subject of recent investigation. Not long ago an elevator signal box in a building at Des Moines, Ia., was heard to emit music from a local broadcasting station. A telegrapher in New Jersey was amazed to hear his instruments talk and sing. In a Swedish village store, folks thought they heard spooks when a shovel

on the wall repeated everything broadcast from a near-by station.

The explanation of experts is that each of these loudspeaking objects chanced to be close to an electric power line connected with a broadcasting station, and that each object was set into vibration by powerful electric impulses passing over the line. Much the same thing happens when the diaphragm of a telephone receiver is set into vibration by electric impulses in a telephone wire.

Most Mishaps Avoidable

AWORKMAN at a cutting machine was disturbed over a quarrel with his wife. In a moment of distraction he forgot the knives and a serious accident resulted. Another man, operating a huge press, was worrying over a mortgage on his home. Failure, for an instant, to attend to his job nearly cost him a life. Looking out the window at a girl who was passing on the street caused a mechanic in an automobile factory to make a costly error which lost him his job.

An analysis of 75,000 industrial accidents, recently completed by H. W. Heinrich of the Travelers Insurance Company, revealed, he says, that a workman who is mentally disturbed is as much of a danger to himself and his fellow workmen as if he were physically disabled. Factory foremen, he adds, would prevent accidents by studying their men for signs of mental distraction. Of the 75,000 accidents analyzed, he declares, at least ninety-eight percent could have been prevented.

In Germany motion pictures are being used to study mental disorders. In a room where the patient has been left alone a hidden and noiseless camera records his behavior and expression. Later the films are studied by experts.

Psychology, a young science, is being applied in increasingly valuable ways.

Measuring Sunburn Rate

HOW long can you lie on the beach without being painfully sunburned? Many a bather has experimented, to his sorrow, to find that his skin is surprisingly sensitive to the penetrating ultra-violet rays of sunlight.

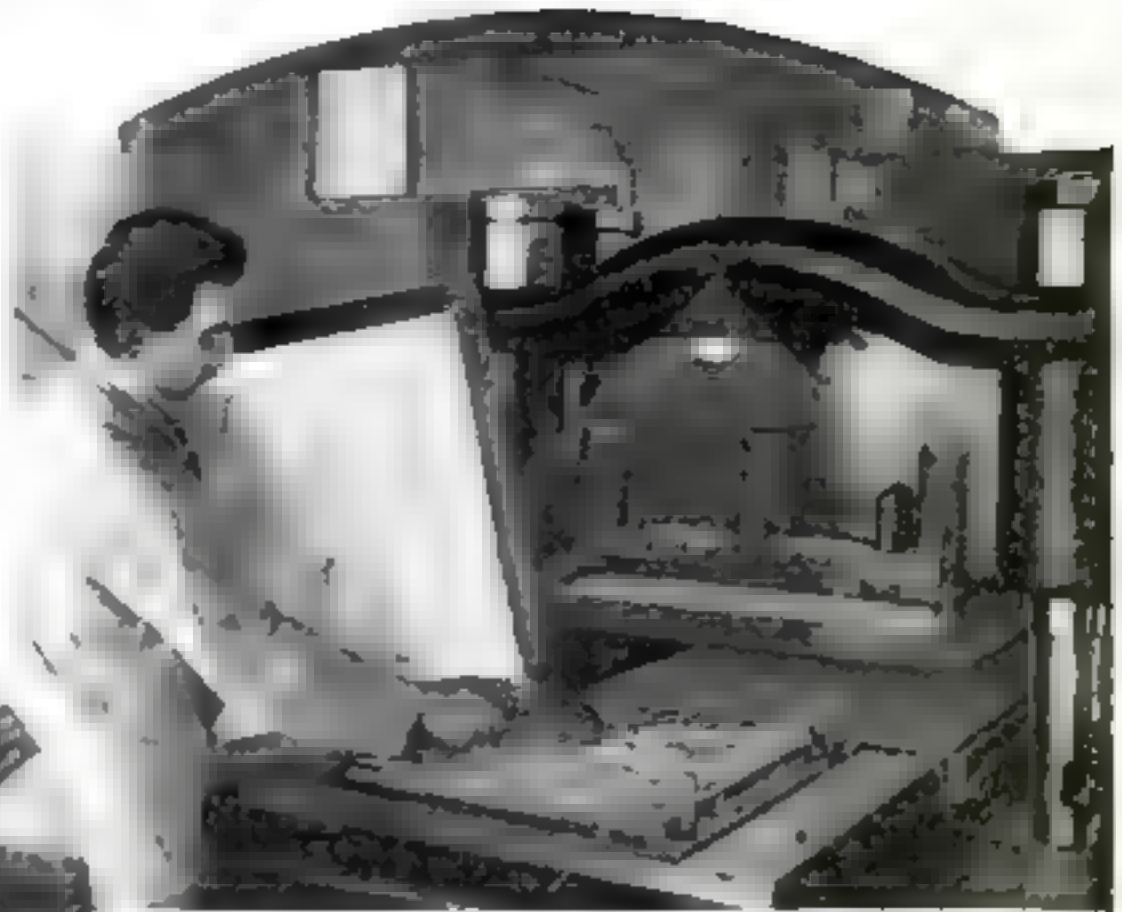
But now Dr. Robert C. Burt, of Pasadena, Calif., has invented a new instrument which, in a few minutes indoors, will tell just how easily you sunburn—without the chance of blistered shoulders and sleepless nights. The apparatus employs a quartz tube mercury vapor lamp similar to those used in producing ultra-violet light in the treatment of disease. Artificial sun rays from the lamp are focused on a small area on the bare skin, and the rate at which this skin burns shows how sensitive you are. From this you can tell how long you can (Continued on page 131)

Machines Cure Colds and Sleeplessness — Marconi Tells Plans for New Beam Wireless That Will Move Like Searchlight—Young Students Make Diamonds From Old Stick of Carbon



Relief Maps Made by Machinery

An artist retouching and coloring a map in Germany made by a process so inexpensive that every house and almost every hotel may have one.



Maps Like Real Land Stamped on Cardboard

A metal die stamp runs an original map made of plaster & stamps the plaster on cardboard. A map is sent about by traveling the hydraulic press.



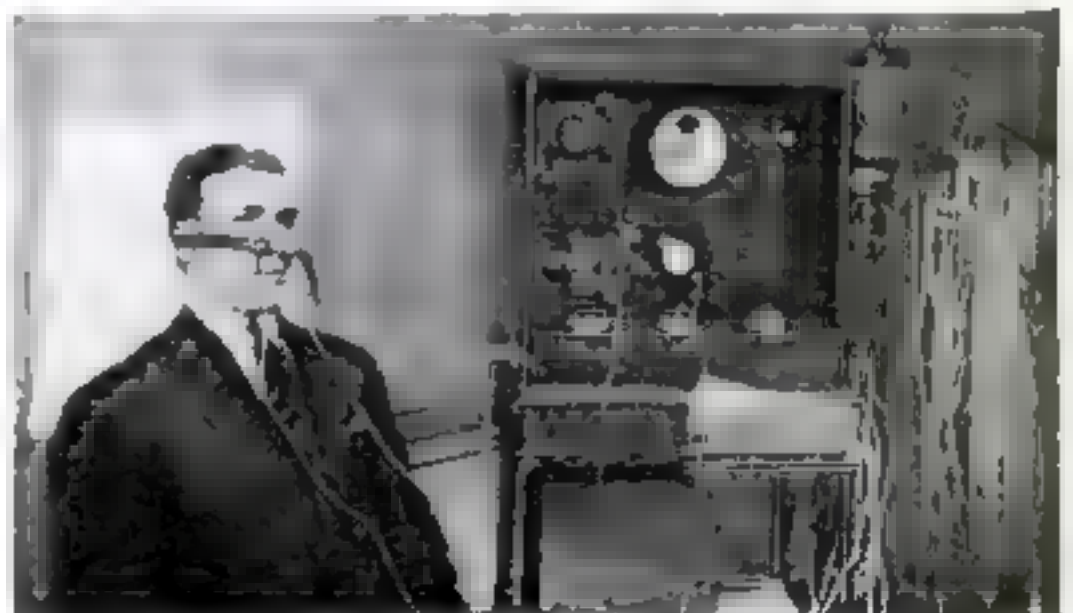
Machine Beats Soporific Drugs in Producing Sleep

Dr. Hans Salmons of Berlin, holding watch, whose device produces a buzz that put him at right to sleep while the other, who took a drug, remained awake.



Twin Boy Students Make Diamonds

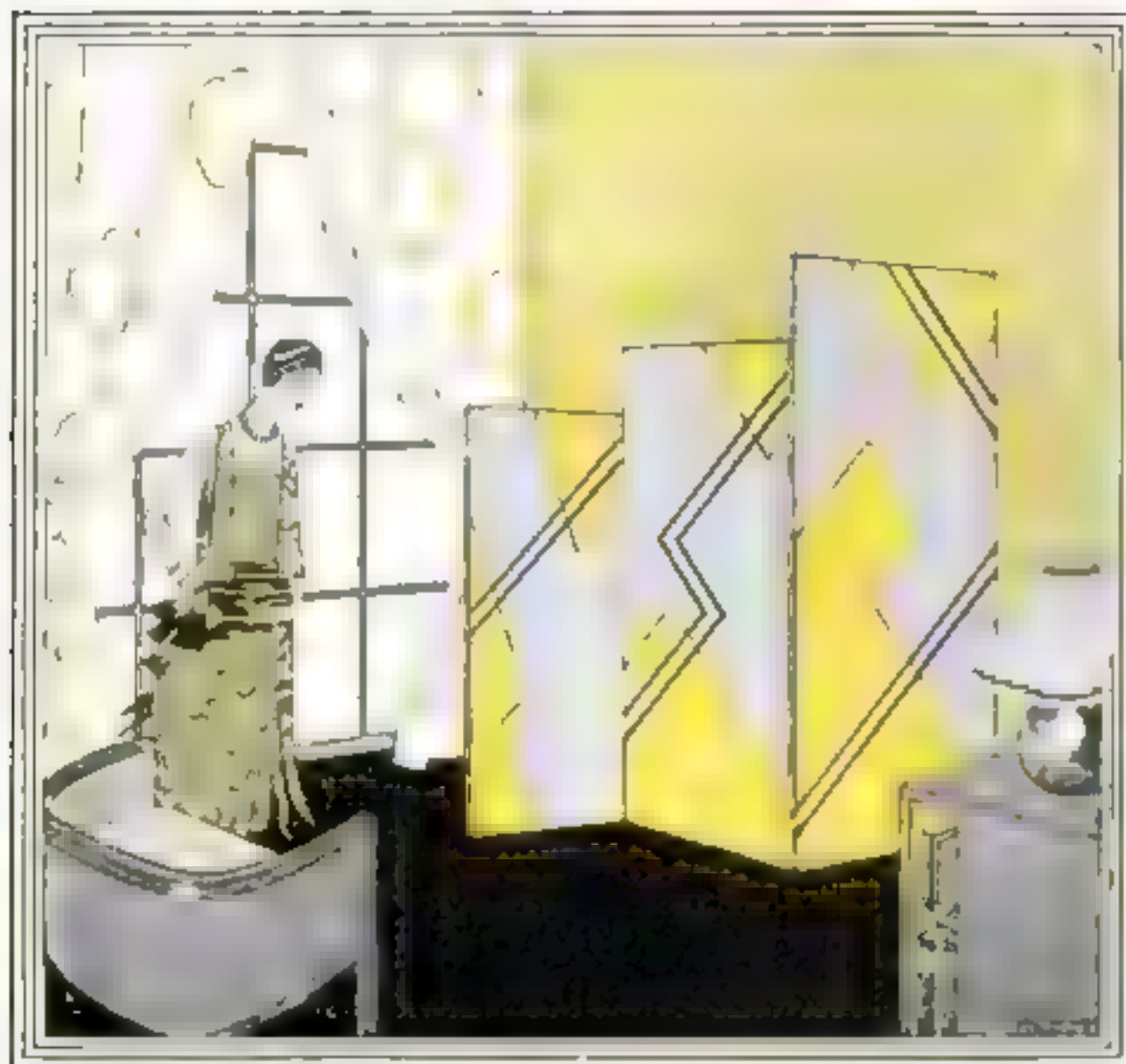
From an old stick of carbon, Gordon (left) and Everett Gravenhorst, schoolboys of Brooklyn, N. Y., shown with some of their apparatus, have made a pair of microscopic diamonds.



Electric Machine Cures Cold in Few Minutes

Prof. Bordier, University of Lyons, France, is seen here demonstrating his device that applies to the nose tiny plates which send high-frequency current into the inner tissues, relieving the congestion and killing the germs that are the cause of the cold.

Making Modernistic Screens



Like the light and shadows falling from a set-back skyscraper is the brilliantly modernistic pattern of this unusual yet simply made folding screen. It will strike a note of modernity in any room.

MODERNISTIC furniture is so stimulating as to take one's breath away. It is at once severe and angular, crystalline and scintillating. You may not like it at first, but it grows upon you and often ends in fascinating you.

Folding screens decorated in the modernistic manner offer the amateur craftsman an especially easy and natural way in which to introduce the new mode into his own home. They can be placed in rooms containing period or commercial furniture without upsetting the harmony of the decorative scheme. At the same time, if the colors are happily chosen to suit the surroundings, they will add a brilliant touch of modernity.

"But I cannot see any rhyme or reason in these new styles," you may object. Perhaps not—but that may be because you have not paid much attention to the exhibitions, window displays, and advertisements of furniture and accessories in the modernistic style. The truth seems to be that those who are the most skeptical when they first see the new designs become later on the most enthusiastic about them. That is because the style is characteristic of the time in which we live—the machine age.

It is the added leisure which machines and mass production have given us that makes it possible for many of us who are mechanically or artistically inclined to buy a few tools and arrange a workshop in which to gratify our inherited instinct

for manual activity. Strangely enough, we can take the very designs which have been planned for mass production and derive the keenest pleasure in applying them to pieces we make by hand like craftsmen of old.

Folding screens, besides being useful and decorative, are very easy to make. Three or four frames are hinged together with what are known as screen hinges, that is, double-acting hinges, which can be obtained from the larger hardware stores. These hinges allow the frames to swing in either direction. Each individual frame consists of two vertical and two, three, or four horizontal pieces, depending upon the height.

Your lumber dealer will have in stock wood suitable for the frames. The sidepieces, or stiles, can be $\frac{3}{4}$ or $\frac{1}{2}$ by $1\frac{1}{2}$ in. and the crosspieces the same thickness and 3 in. wide. When plywood or stiff pressed wood is used as a covering, the stock for the frames can be as thin as $\frac{3}{4}$ in. The size of the completed screen depends mainly upon where and how it is to be used and partly upon the design. Threefold screens with panels 20 in. by 5 ft. or 5 ft. 8 in. are generally satisfactory, as are fourfold screens with panels 15 in. wide.

The advanced woodworker



may join the frame members with mortise and tenon joints, but for the man or boy with limited experience the dowel construction illustrated on page 100 is much easier and quite satisfactory. The most important requirement is to lay out all pieces of similar length at the same time and cut their ends absolutely square. Auster box, even if only a cheap wooden one, is a great help in making square cuts.

FIRST nail together the sides and the top and bottom pieces of each frame. Use thin finishing nails about $2\frac{1}{2}$ in. long and drive two nails into each joint, spacing them at the outside as if there were to be a third nail driven between them. Allow their heads to project sufficiently to be easily withdrawn. Now, instead of driving the third nail between them, bore a hole with a $\frac{3}{4}$ -in. (No. 8) auger bit right through the sidepiece and well into the crosspiece. Insert a $\frac{3}{4}$ -in. wooden dowel rod in this hole. Dowels often can be purchased in hardware stores; they also can be obtained from woodworking plants and cabinetmaking shops and large general mail order concerns. They can be made, too, by using either a so-called "dowel plate" or a dowel turning tool, which is sold by the larger hardware stores.

Cut off the dowel so that it projects about $\frac{1}{4}$ in. from the sidepiece. Withdraw the other nails one at a time, bore holes in their place, and insert dowels as in the center hole.

After all the joints of the frame have been assembled in this way, take it apart, put glue on the edges to be joined, let a little glue run into the dowel holes, dip the dowels themselves in glue, and drive them home. Glue the top and bottom pieces together first; then insert the middle pieces.

If one or two carpenter's bar clamps or improvised home-made clamps of any kind are available, they will be useful in making tight joints. Small blocks with a $\frac{1}{4}$ -in. hole in the center should be placed over the projecting central dowel in each joint, so that the pressure of the clamp will be transmitted directly to the frame and not to the dowels. When the frames are dry, the projecting dowel ends are sawed off, and the joints are smoothed with a plane.

The frames may be covered with a variety of materials, depending upon how they are to be decorated: fiber wallboard, pressed wood, plywood, imitation leather, burlap, parchment,



A design of the more conservative type yet quite modern in spirit. Use three similar panels.

How You Can Construct, Without Straining Your Pocketbook, the Popular Ultramodern Pieces

fabrics, wall paper, oilcloth, Japanese wood paper, metal foil or leaf, sheet metal, or what you please.

Several designs are illustrated and more are shown on Popular Science Blueprint No. 91. You will find this blueprint, which can be obtained from the Blueprint Service Department for 25 cents, of considerable assistance in making any one of these screens because the drawings are much larger than any which can be reproduced in the magazine. The blueprint also contains a complete bill of materials, list of tools, and outline of operations.

All but one of the screens illustrated on these pages and shown on Blueprint No. 91 were designed by Herman Hjorth, one of the country's leading teachers of woodworking, in collaboration with William H. Varnum, Associate Professor of Applied Arts at the University of Wisconsin. The exception is the screen represented in the larger illustration on this page. This screen is the work of J. Warren Campbell, a New York designer, and is similar to one which created much favorable comment recently at an exhibition of the Tenor (N. J.) Guild of Artists.

THE first screen—the one appearing in the larger illustration on page 58—may be painted in the colors indicated or any suitable color scheme. As originally designed, the covering was blue imitation leather, with black lines and gilding to complete the decoration. Brushing lacquer can be used for the black or other applied colors; and gold bronzing powder mixed with banana oil or bronzing liquid, for the gilded areas.

One method of getting the lines of the design absolutely straight is to apply gummed paper tape to the edge of each contour to serve as a mask, and then paint one color, letting the brush overlap the edge of the paper. When the surface is thoroughly dry, dampen the paper sufficiently to allow it to be removed, wash off any surplus gum, and apply more tape, laying the edge over the areas already painted so as to mask them.

Another way of obtaining a straight, true line is to use a tool called a "painter's time-saver." This consists of a piece of thin metal shaped in such a way as to resemble an inverted dustpan. It is held right on the line and the strokes of the brush overlap the edge. This tool is sold in many paint stores.

The screen may be finished by fastening a strip or gimp of the blue material around the edges with fancy brass nails. If pre-



By striking off the top of each panel at an angle the designer of this most original screen has heightened the strong, dynamic effect. It makes a vivid piece for use with other modernistic furniture.

ferred, the edges may be painted black, blue, or gold.

It will be noted that the decoration of this screen is suggestive of the light and shadows that fall from a set-back skyscraper on the wall of an adjoining building.

The screen illustrated below it, which is marked E, can be made in various ways. One is to cover the frames with smooth fiber wall board on both sides and paste on squares of Japanese wood paper or any fabric or paper which gives the effect of fine parallel graining. Even a

slight difference in the markings or texture will be sufficient to set off the squares when they are arranged alternately as shown.

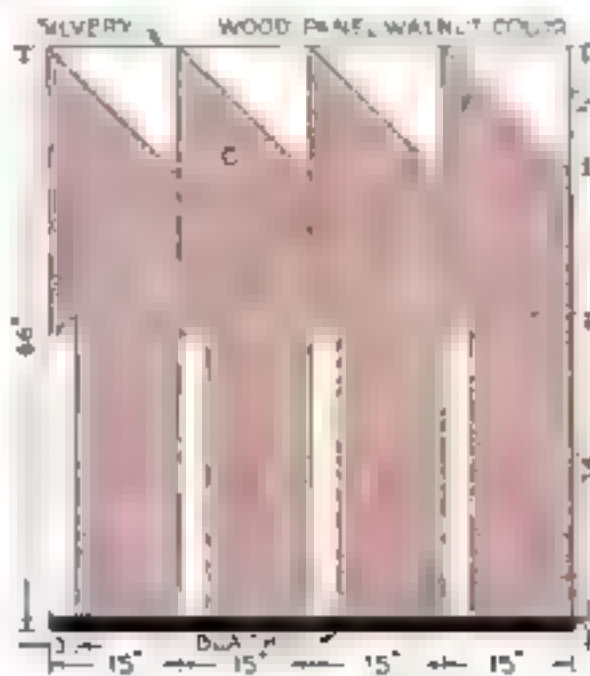
The color scheme of the third screen (that designed by Mr. Campbell) is blue red, and black on a silver background, although all these could not be shown in the reproduction. The base, which is black, is ornamented with a very flat hand-carved molding picked out in silver and red. Obviously,

the base could be omitted, or simplified by merely painting on the ornamentation instead of using a molding. The fourth screen (that marked C on this page) is made by fastening plywood panels to the face of each of the four frames.

THE plywood, if birch, whitewood or other light colored wood, is stained a light walnut color except for a 2 in. wide strip at the bottom, which is either stained or lacquered black. Silver powder mixed with bronzing liquid is then applied to the wood as indicated. The back of the screen can be lacquered or stained in any inconspicuous way.

Another method of making screens is to stretch burlap tightly over the frames and give it a sizing coat of very thin shellac. After that a coat of gold bronze is applied and any suitable floral design painted on freehand. One such design is shown on Blueprint No. 91. A gimp of harmonizing color or of black or gold is fastened around the edges with black or green metalene nails. A simpler method is to apply a high grade wall paper to frames covered either with burlap or wall board.

It will be understood that these are merely suggestions. If 3/4-in. plywood or fiber board is used for covering the frames on either one or both sides, it should be nailed in place with 5/8-in. brads, which should be set below the surface with a fine nail set. The edges must be planed and sandpapered. (Continued on page 109)



A plywood-covered screen with the natural wood grain forming most of the surface.



Fig. 1. Small and very simple model of a reefer Baltimore clipper. The sails are of wood.

How to Whittle a Ship Model

A Few Scraps of Wood, a Knife, and a Shady Seat Outdoors Are All You Need to Make This Privateer

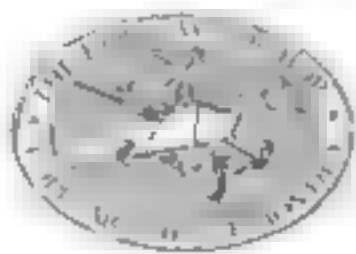
By E. ARMITAGE McCANN, Master Mariner

BECAUSE the weather is hot and we wish to be outdoors, it does not necessarily follow that we must discontinue our ship model making. We can follow the example of the old-time sailorman who gathered some scraps of deck planking and sat on the fore hatch and whittled a model of his ship. He could make the hull, spars, sails, and everything of wood, with just a few threads of rigging added to give the model an appearance of completeness. And we can do the same. Indeed, some who may have considered the work on our previous scale models a bit tedious, will find more pleasure in making a small and very simple model.

I made the one illustrated in Fig. 1 with a hull $5\frac{1}{4}$ inches long, which gives a model 8 by 6 inches over all. Of course, it could be made larger or smaller.

You have often read about "long, low, raking craft" in pirate and privateer stories. This is a model of one of them—a picturesque Baltimore clipper of about 1812. Some of these craft were as long as 100 ft., and their rig was that of a topsail schooner. They carried a heavy press of canvas and were the fastest craft afloat.

As with all ship models, it is desirable to work from full size drawings. These you can obtain by sending twenty-five cents to the Blueprint Service Department of POPULAR SCIENCE MONTHLY for Blueprint No. 92 (see page 102).



For wood to make the model, I went to the scrap box and picked a bit of oak for the base, rosewood for the hull, amaranth for the deck fittings, hazel for the spars, and yellow cedar for the sails. These give contrast and color without the use of paint or stain. It is not necessary, however, to use these or similar woods. The hull can be made very easily of white pine and will look well if either lightly varnished or painted in realistic colors.

Figure 3 shows the shape of the hull. The whole hull is given so that those who prefer to make a model to be set in a cradle, instead of merely a water-line model, can do so. Those who wish to copy my model, however, will make the hull only as far as the cut-off line, which is marked C. For this a piece of wood $\frac{3}{4}$ by $1\frac{1}{4}$ by $5\frac{1}{4}$ inches will be required.

Mark a center line around this—top, bottom, and ends. On the top mark the bulwark line, which is the outer line (marked "deck outline") on the half-breadth plan. On the bottom of the block mark line C, as in the half-breadth

plan. Shave the wood down to these two curved lines and cut the two ends to the profiles which appear on the sheer plan. Then cut the top of the hull to the slightly hollow sheer line.

To do the rest of the whittling you will be guided by the body plan, which shows the cross-sectional shape of the hull at the various station points, which are marked from 1 to 8 and are $\frac{1}{4}$ inch apart, measured from the stern.

The stern and the sternpost may be left on or they may be ignored at the time the hull is whittled and added later, together with the rudder.

NEXT hollow out the top of the hull to the deck, leaving the bulwarks standing. A small chisel is an aid in this, and the finishing can be done here, as everywhere, with coarse sandpaper followed by fine.

The whole model can be made easily enough with a jackknife; on the other hand, it can be constructed almost entirely with machine tools. A happy medium is the best to choose; that is, a saw for roughing out, a chisel for such processes as that just mentioned, a flat gouge to hollow the sails and carve the waves on the base, and a fine twist drill or awl. The advantage of this model, however, is that if you are working outdoors you can get along with nothing more than your pocketknife. *(Continued on page 114)*

Outboard Racing Secrets

How to Coax More Miles an Hour from a Light Motor Boat—Fuel, Lubrication, and Ignition Hints on Choosing Both Hull and Power Plant

By NEWCOMB LEONARDE

SPEED—how to get more speed—is the topic of the day with the outboard motor boat owner. In the past few years the speed possibilities of these little craft have increased so rapidly that today it is not unusual to hear thirty miles an hour talked of, whereas a short time ago the utmost expected was ten or twelve.

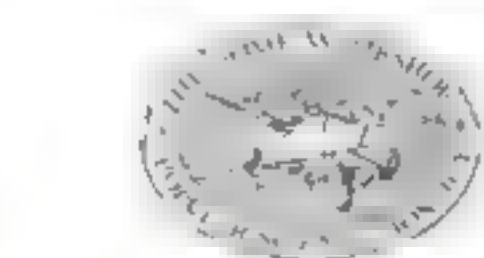
A large part of this increase in speed is due to better designed hulls. The rowboat of flat-bottom vintage is no longer good enough, for the outboard motor manufacturers have given us power plants that call for the best the naval architect and boat builder can design and construct.

How to get the most speed out of an outboard motor is not alone a question of fuel, lubrication, and ignition. The "speed bug" must provide himself with a well-designed speed type hull, either V-bottom or step hydroplane, both of which have their ardent supporters among experts.

As to the size, it may be anything from the little eight-foot scow type to the sixteen foot sea sled, and the cost may be anywhere from twenty-five dollars to four or five hundred. Each calls for a particular type of outboard motor, for the sport has developed "classes" just as in the larger speed boats. For the higher speeds, the larger motors are an absolute necessity, and it takes one of the eight-horsepower motors to drive a twelve- or fourteen-foot boat along at from twenty to twenty-five miles an hour. The large "twins" or the new four-cylinder motors are required to get a speed of thirty miles or more.

FOR illustrative purposes we will assume that you have just purchased one of the high-powered twins. As nearly all the outboard motors are of the two-cycle variety, in which good compression is most important, you will need to take particular care in breaking it in. Twenty or more hours of steady running at moderate speed will be needed.

Do not under any circumstances forget to give it plenty of oil at this time. Even if spark plugs do foul and have to be changed, ample lubrication during this breaking-in period will do more to insure good results later on than any other one thing you can do.



Winning boat in a recent "free" trial. It will run 22 miles an hour with a Class B motor and 30 if more heavily powered.

A pint of oil to each gallon of gasoline is the usual proportion, and they should be well mixed before being put in the motor tank. As much as a quart of oil to each gallon is often used for the newer and larger motors. A high-grade medium gas engine oil should be used. Most manufacturers recommend for their motors a particular brand. Some advise castor oil for racing. This undoubtedly does give better lubrication for maximum speeds. It should be remembered, however, that castor oil will not mix with gasoline, so it must be fed through a drip cup.

High-test gasoline is, of course, a necessity if one expects the utmost speed of which the motor is capable. Some racing drivers dope their gasoline with ether (sulphuric motor ether) or benzene and believe that they get a little more power. A well-tried speed mixture is seven quarts high-test gasoline with one half pint of

ether and the amount of oil called for in the manufacturer's directions. Personally I prefer straight high-grade gasoline.

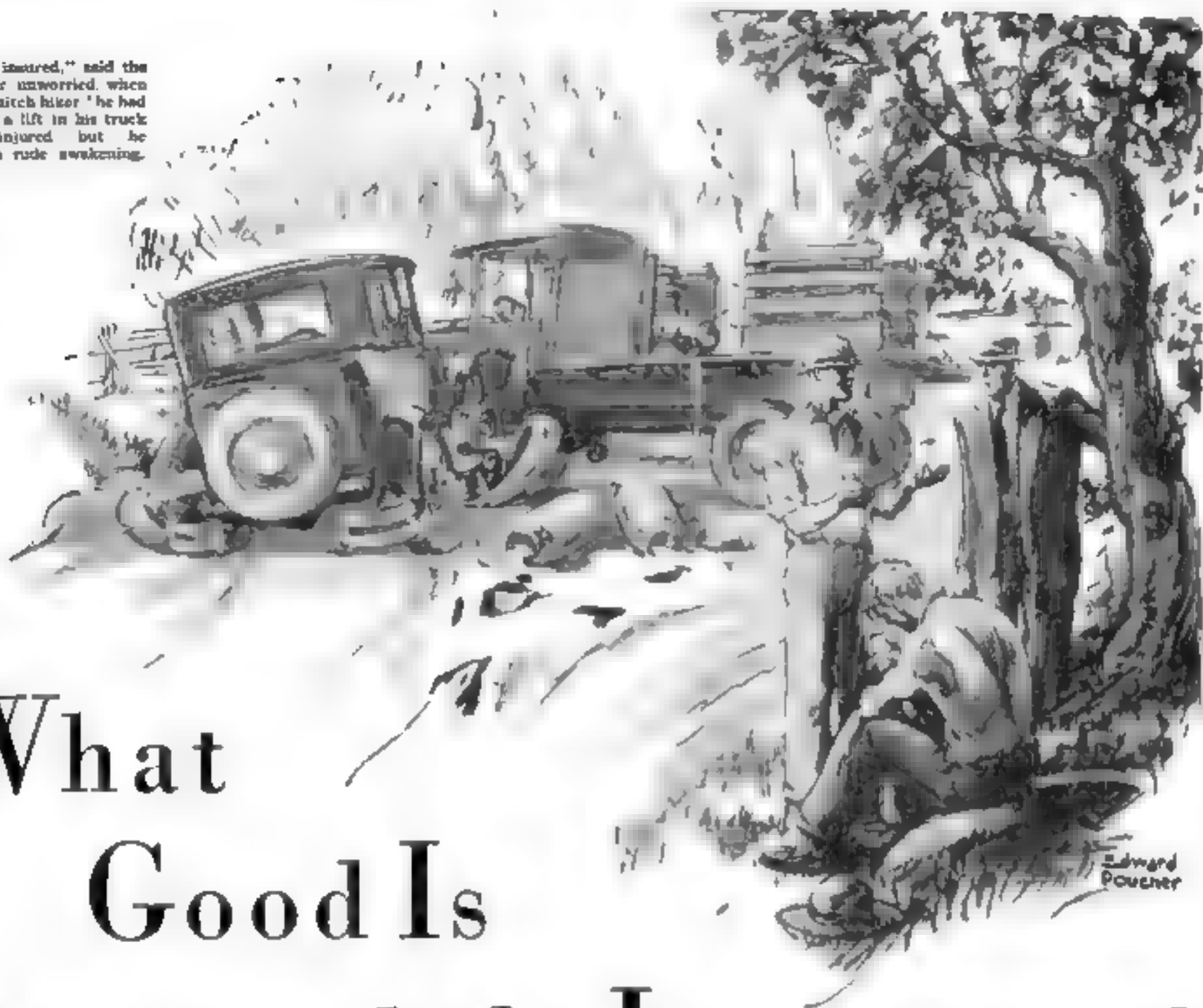
Carburetor adjustment must be studied if the operator expects top-notch results. It must be remembered that the carburetor adjustment on a two-cycle motor is quite different from that on the four-cycle motor used in automobiles. The adjustment must be quite rich for starting purposes, but after the motor has warmed up, the needle valve should be turned down. A good way to tell whether your motor is running at its maximum speed is by using a tachometer.

This insures the right explosive mixture to give best results and highest speed. Since there is compression in the crank case of a two-cycle motor, it must be realized just how important are tight crank bearings so that no excess air may leak in or out.

AND this brings up the question of ignition. Some motors use magneto ignition only, some battery only, and some a combination. Whichever your motor has, it is important to see that the spark plugs are clean and the gap adjusted exactly according to the directions. The magneto contact points or battery breaker points also should be adjusted to a nicety with a feeler gage. The usual gap on magneto-fired engines is .016 in., and on battery-fired motors .016 to .012. Of course, all ignition parts should be kept dry and free from oil.

Not the least important detail to be watched is the straining of the gasoline. It is not enough to strain it through the gauze of the (Continued on page 63)

"I'm insured," said the farmer unworried, when the hitch hiker he had given a lift in his truck was injured but he had a rude awakening.



What Good Is Automobile Insurance?

Sometimes It Protects You and Sometimes It Doesn't, And This Article Tells Why How to Study Your Policy

By CARL HELM

THE day was boiling hot. A sympathetic farmer, driving his truck home from town, stopped to pick up a weary "hitch hiker." A few minutes later the truck collided with another machine and the hiker was injured. He sued for \$10,000 damages.

"I'm insured," said the farmer, unworried. "The company will take care of it." He sent the court summons along to his insurance agent. But the company replied:

"Your policy was for a commercial vehicle, and when you carried a passenger you automatically relieved the company of all liability for accident damages. Sorry, but you will have to stand the consequences yourself!"

"But I wasn't carrying this fellow for hire," the farmer protested, going to his lawyer. "I was only giving him a lift."

The attorney read the insurance policy through until he came to this paragraph:

"This policy shall exclude any obligation of the company as respects bodily injury to any passenger while an automobile described as 'Commercial' is being used for passenger-carrying purposes, regardless of whether or not a compensation is charged."

Suppose that accident had happened to you. Have you ever read your policy through carefully? Do you know what you are "covered" against and what you are not?

LAST year 31,000 men, women, and children lost their lives in automobile accidents in the United States, and ten times as many were injured. Conflicts for right-of-way at crossings, speeding, driving on the wrong side, failure to give proper signals, and "cutting in," in the

order named, caused that alarming casualty list. Motorists are being driven to insurance for protection, and more than fifty percent now have automobile "coverage" in one form or another.

BUT automobile insurance does not cover every kind of accident nor protect the policy holder in any and all circumstances. Before he goes spinning blithely over the highways the motorist should know about the "exclusion clauses" in his policy—little "ifs," "ands," and "buts" that may some time cost him dear.

Remember this: Report to your insurance company every accident that may happen to you, regardless of whether damage is done. Make the report in writing and immediately. Failure to do so may render your policy void.

A business man, "hitting it up" to keep

an early appointment, collided with another car. He left his damaged machine at the scene and took a taxicab. Hours later he remembered to telephone his insurance company. The company was "awfully sorry, but—!" He had not made a prompt report and he had left his car unguarded for hours, without waiting for the garage man or the insurance adjuster to arrive. Either omission, he learned, was sufficient to nullify the policy.

The theft-insured motorist who expects a new car if somebody "steals the old bus" should remember that the insurance companies limit their liability to "not to exceed the actual cash value of the automobile at the time of the theft." Also they specify that they "shall have the right to return a stolen automobile or its equipment, with compensation for physical damages, at any time before actual payment is made."

AND, in addition, theft policies do not, by any means, cover theft in any and all circumstances.

A little middle western storekeeper's clerk ran off with his employer's car.

"I'm afraid you're out of luck all around," the insurance investigator told the owner. "You should have reported the theft immediately."

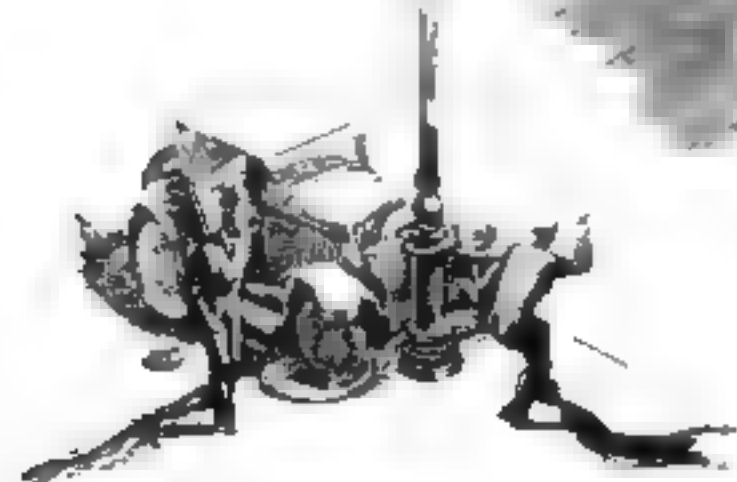
"But I didn't think he had stolen the car," the storekeeper explained. "I wanted to give him a day or two key-way before I turned him in as a thief."

"We might let that part pass," replied the investigator. "But under 'Section G, Definition of Perils,' the company specifies that it shall not be legally liable to pay your claim."

The section indicated said the company would pay claims for theft, robbery, and pilferage.

"Excepting by any person or persons in the assured's household or in the assured's service or employment,

The car commandeered "by civil authority" to pursue bandits was wrecked. The company was not liable for damage in these circumstances.



You are required, if asked, to help the company fight your battle, even assisting in the court trial.

A BUSINESS man would not think of signing an important business contract without first examining carefully every word in the agreement. Yet many a man thinks his automobile insurance policies, which he has no more than glanced at, will "cover" him, whatever happens.

Through this negligence more than one motorist has burdened himself with debt for years to come.

Reputable insurance companies do not slip "jokers" into policies to defraud their policy holders. But their contracts do legally place upon the automobile owner definite obligations. It is up to you to know exactly what those obligations are.

When you have read Mr. Helm's extremely valuable article, you will know exactly why you must **READ YOUR POLICY**.

You owe that precaution to yourself and your family.

The motorist should read carefully each word of his policy then he will know what he is protected against and will know against what he has no protection.

whether the theft, robbery, or pilferage occurs during the hours of such service or not."

And the "exclusion clause" had still another kick in it.

"... and excepting loss suffered by the assured from voluntarily parting with title and

or possession, whether or not induced so to do by any fraudulent scheme, trick, device, or false pretense or otherwise."

In the matter of personal liability insurance, the insurance companies only pay not to exceed the amount of damages specifi-

cally listed in the policy. Suppose your policy is one of the popular "10-20" variety—the company to pay a maximum of \$10,000 for any one death or injury caused by your car, and \$20,000 for more than one death or injury.

Suppose your car kills a prominent banker and a lawsuit results in judgment against you for \$30,000. The company will pay \$10,000—and no more. The remaining \$20,000 must be made up by you.

A FRIEND of the writer was driving home in the rain one night when a pedestrian, his vision obscured by an umbrella, stepped into the side of the machine.

The man wasn't even knocked off his feet, but the motorist stopped and, while the crowd looked on, promised he would "fix everything up all right."

He didn't report the incident to his insurance company—it didn't seem "worth making a fuss about."

But before the month was out the pedestrian had sued him for \$5,000, declaring a nervous disorder had been induced by "the shock and shaking up."

My friend's insurance company disclaimed liability because he failed to report the incident immediately and because he had apologized and seemingly accepted blame.

BE CAREFUL about assuming blame or offering to "fix things up." The policy does not prohibit you from arranging and paying for first aid treatment or "immediate surgical relief," but

it does specify that your voluntary contributions shall stop at that point unless you are prepared yourself to stand the entire expense. In the words of the insurance contract, the motorist "shall not voluntarily make any payment, assume any obligation, or incur any expense," except for the emergency surgical relief noted.

Even after you have made the proper reports and complied with all the rules and regulations, you are required to help the insurance company fight your battle if it asks you to. If requested you must assist in preparing evidence and rounding up witnesses.

Your automobile collides with another machine. If you have property damage insurance, the

(Continued on page 143)

New U. S. Submarine, Largest in World, Is Also the Safest

THE V-4, largest submarine in the world and latest to be commissioned for service in the U. S. Navy, will not lack for safety devices. Its great size permits many that would have overburdened smaller craft, the Navy announces, and the giant boasts 108 provisions for the safety of its crew.

Among the most important features are three separate escape hatches, instead of one as formerly. By their use a trapped crew could crawl out through the ship's side in fairly shallow water. Older submarines had one hatch in the conning tower, forcing a person escaping upward to face a downrush of sea water. The inflated A-4's conning tower was smashed, making even this impossible.

Independent air lines for each compartment make it possible to pump air to men within the new undersea craft no matter where they are. There is an independent supply of fresh water in each compartment, so that it can serve even if the rest are cut off. All hatches can be opened from inside or outside—thus rescuers can enter if the crew is helpless.

annual \$1,400,000,000 revenue.

The research would lead to the discovery of new deposits and the better exploration of known ones, Dr. Lindgren avers; our knowledge of how ores came into being and where to look for them is all too fragmentary. Other questions he would like to have answered are how fissure veins are filled with minerals; whether there are lead and zinc buried deep in the Mississippi valley as well as near the surface; and how metals separate from molten rock to be deposited in adjoining rocks.

New Use Found for Cadmium

NOW a new use has been found for cadmium, brother metal to zinc and, combined with other chemicals, the chief ingredient of brilliant yellow paints with which we are familiar. It has recently been utilized in the making of special new solders that fuse at unusually low temperatures. Ordinary solders—such as are used to seal tin cans—contain lead, tin, and zinc; but when cans have colored lithographed labels intense heat discolors them and hence a low-melting solder is required. Cadmium has been found to be a useful component of such a solder. Carl E. Swartz, Selby, Calif., metallurgist, recently

told the American Institute of Mining and Metallurgical Engineers.

New Perfume in Paste Form

SOLID perfumes to replace liquid scents have appeared in this country following their recent introduction in Paris. Intended for travelers in particular, they are in paste form and are applied to hair, neck, or clothing. Ordinarily paste obtained by boiling flowers in fat is distilled to make perfume, but the new scents are simply the undistilled paste.

Phone on Aerial Fire Engine

FIRE engines are keeping pace with the mechanical progress of this fast-moving world, as the remarkable photograph at the right shows. The latest engine, recently demonstrated in London, is a combination pump, fire escape, monitor, and searchlight, with amplified telephonic communication with the ground. The fireman at the top of the 85-foot escape can telephone to comrades below.

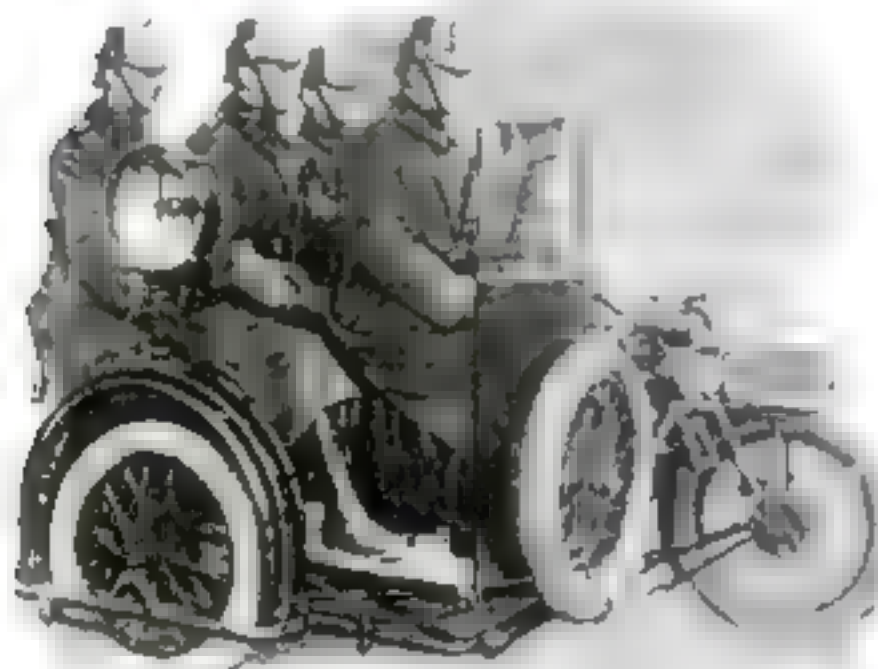


Truck Driven from Outside

HOUSE to house delivery is expedited by a new truck which the driver may operate from the running board as well as from the driver's seat, says a Virginia dairy company that has installed it. The truck, its makers say, is so noiseless that it won't wake sleeping customers.

Clock Can Be Seen 20 Miles

AT A distance of twenty miles or more, when the weather is fair, you can tell the time by a remarkable new electric clock that has recently been installed in Baltimore. It faithfully indicates the hour by red and white flashes from sixteen huge electric lamps.



Motorcycle Carries 5 Police

A FIVE-PASSENGER motorcycle that can outdistance a motor car is the latest addition to the Berlin police department. The German invention carries besides its crew a powerful searchlight, emergency rescue apparatus, and a spare tire. Three officers sit in a novel two-wheeled side car, and a fourth rides on a tandem seat behind the driver.

Baffling Mysteries of Mining

HOW did radium, most costly mineral in the world, and vanadium, valuable ingredient of modern alloy steel, happen to become concentrated in the sandstone rocks of southwestern states? Under what temperatures and pressures is gold deposited in quartz? To answer such questions, Dr. Waldemar Lindgren, chairman of the National Research Council's Division of Geology, urges that the mining industry establish a laboratory of the first order, at a cost that would be a small fraction of the industry's



A fireman 85 feet in air on the remarkable new English aerial pump and rescue tower, saving a smoke victim and telephoning to his chief on the ground.

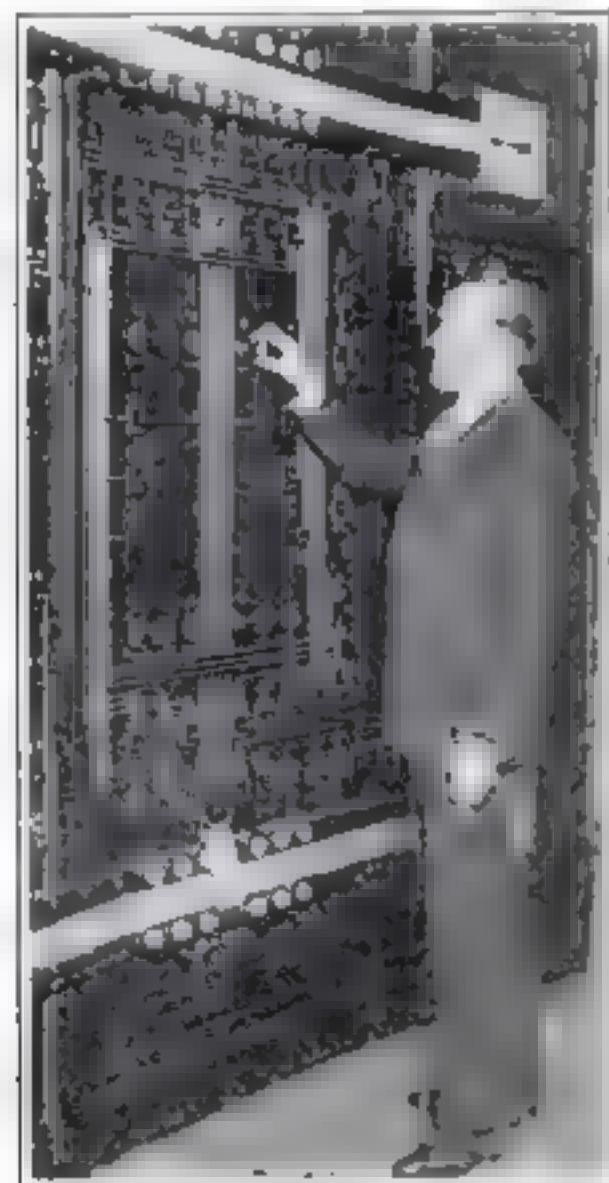


New Engine Slashes Gas Bill

MORE than twice the power of an ordinary engine with less than half the fuel consumption is the claim made for a new type of motorcycle engine introduced by an Australian inventor. The engine develops twelve horsepower, and in a demonstration before the High Commissioner of Australia, shown above with the inventor, is reported to have made close to 14,000 revolutions a minute.

20 Billion Ice Cream Cones

ENOUGH ice cream to make twenty billion ice cream cones is America's consumption each year, a recent estimate states. In twelve months' time, we eat



George T. Riley, operating executive, controlling traffic in tubes under the Hudson and keeping the air free from deadly gas, all by throwing switches.

324,000,000 gallons, according to figures placed before the International Association of Ice Cream Manufacturers at Atlantic City, N. J.

Autos Lead in Use of Power

NEARLY seven hundred million horsepower—enough, if converted into man-power, to furnish every man, woman, and child in the United States with sixty servants—is the total capacity of all the power generating equipment installed in this country, ac-

cording to the latest exact figures, for 1923, just released by the U. S. Department of the Interior. This estimate includes every kind of power-producing device from the largest steam turbine to the

One of the light and speedy new tanks with which the British Army is equipping some cavalry units, dispensing with horses.



erratic windmill and the farm work animal.

An astonishing fact is that passenger automobiles make up the major part of this total. Their combined power has been found to be nearly twice that of all the machines used in industry.

One Man Rules Tunnel Traffic

ONE man standing before two huge control boards, one of which is seen at the left, supervises the operation of thousands of automobiles that pass daily through the twin tubes of the Holland vehicular tunnel under the Hudson River between New York City and Jersey City, N. J. Red, yellow, and green lights, flashing on the boards, signal the location of traffic tie-ups or accidents, and the operator summons emergency trucks or diverts the flow of traffic by throwing designated switches. Recorders show by graph the amount of carbon monoxide gas in the atmosphere in the tubes. When buzzers indicate the sections in which there are more than two parts of gas to 10,000 parts of air, the operator pulls a switch to set great supplementary exhaust fans whirling to clear the air.

Gigantic English-Made Bell Coming to American Church

A FEW weeks ago the largest assembly of bell-ringers England has ever seen gathered at Croydon to hear the booming of the biggest bell ever forged in that country—a giant that will be shipped to America to find its home in the tower of a New York City church.

Though it is half as heavy as the famous bell Big Ben in the Westminster Clock Tower, London, it is not the world's biggest, there are numerous claimants for that honor. Moscow has a great dome-shaped affair that was long used as a chapel, also a huge forging called the largest bell that is still a bell. An eighty-ton bell swings in a Burma pagoda, and Peking, China, boasts one of fifty-three tons. Nanking, China, and Vienna, Austria, have giants, too; and Great Peter at Yorkminster, England, and the bell of Notre Dame Cathedral in Paris are famous for their size.

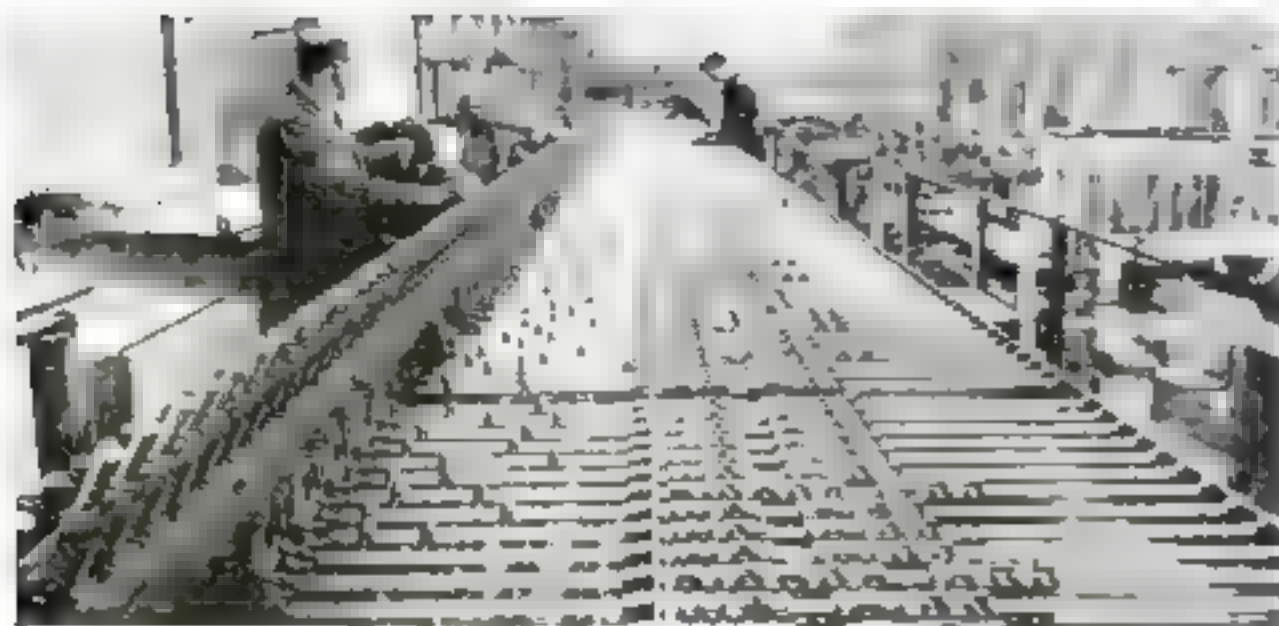
Cavalry Horses of Iron

CAVALRY charges of the future may be thunderous and clanking assaults of platoons of mechanical steeds, as the armies of the world continue to perfect new types of caterpillar tanks for modern warfare. The British Army has begun eliminating horses by equipping cavalry units with baby tanks, and recent tests proved their worth. The tanks have open tops, in contrast with the closed compartments of the World War types.

Tries to Rent Air to Planes

A NEW idea in money-making—the collection of rent from airplanes passing overhead—recently occurred to Samuel Schwarz, owner of a house at Zehden, Germany, who interpreted literally an old law reading, "The rights of a property owner extend to the space above and the ground beneath his property." He wrote to the Lufthansa, the German commercial flying organization, demanding a settlement.

Unfortunately for his ingenious plan, the Lufthansa cited the German air traffic law entitling aircraft to free passage so long as they observed the law.



Westinghouse engineers at Chippenham assembling the gigantic signal control box of the Southern Railway that will direct 2,000 trains a day. The signal system, which is being set up at London Bridge, reaches all trains with its electric "nerves." It is called the largest single system ever built.

Box Controls 2,000 Trains

TWO thousand trains a day whiz along the Southern Railway's tracks in England. This entire stream of traffic is to be controlled by a tremendous signal box at London Bridge. Minute levers that operate the intricate signal system border the control box as far as the eye can see. Its "nerves" are a maze of electric cables. From this single box, operators can direct every train speeding over the complicated network of railway tracks, or, at will, they could paralyze instantly the entire line.

New Ship to Dwarf Leviathan

ALREADY New York is wondering where it will dock the world's biggest liner, the *Oceanic*, whose keel has just been laid at Belfast, Ireland. The great ship's 1,000-foot length will require a longer pier than any yet in existence. It will be finished by 1932.

If it were stood on end, the vessel when completed would far overtop the tallest skyscraper, and would reach exactly to the peak of the Eiffel Tower in Paris. It will dwarf the *Leviathan* by ninety-three feet, and the *Majestic*, longest liner afloat, by eighty-five. The sixty-thousand-ton ship will cost thirty million dollars.

Figures Deny "Race Suicide"

AMONG things to worry about comes the occasional warning, on one hand, of the danger of "race suicide"; on the other, of the peril of an overpopulated earth with not enough food to go around.

Which should cause the most concern? Results of the latest investigations seem to answer "Neither."

A study of sterility, just reported to the National Academy of Sciences, shows that only seventeen percent of American marriages among white people are childless. Only thirteen percent are actually sterile, divorce or death accounting for the other four per-

cent. Among every 100,000 white women, 78,207, more than three fourths, eventually marry. In a country of some 110,000,000 people, such figures are not held to indicate a lack of children to perpetuate the race.

Was Methuselah 969 Years Old?

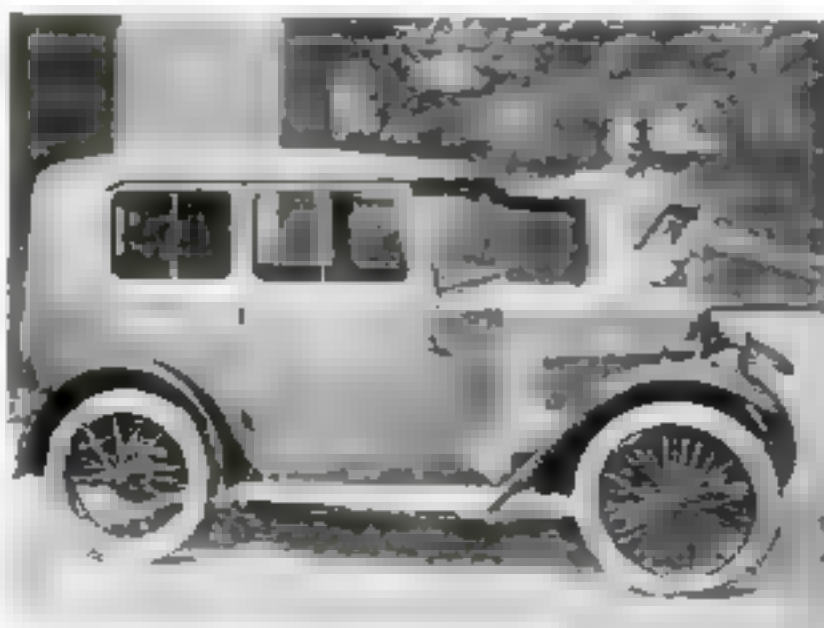
DID Methuselah of Biblical fame, really live to an age of 969 years

—or was that the life of the clan he founded, that bore his name?

The latter is the sensible interpretation, R. P. Field, of Philadelphia, recently told the American Philosophical Society.

The chronicled birth, apparently of a son, to many a patriarch, Mr. Field declares, was not that of a person but of a new tribe that had split off from the father's clan.

All dates of the Old Testament need revision, says Field, who places the time of Adam, for example, between 13,000 and 20,000 a. c.



The 7-horsepower English Rover said to have amazing speed and pick-up. Beside it is an official of the company that will produce it in quantities by methods similar to Henry Ford's.

Giant Zeppelin for Sale; Will Go to Highest Bidder

DO YOU know of anyone who would like a nice, brand-new dirigible for Christmas? If you do, now is your golden opportunity. For the Zeppelin Construction Company of Germany announces that it will be only too glad to sell to the highest bidder the mighty airship LZ-127, now being rushed to completion. The reason is that a plan to use it for commercial voyages between Spain and the Argentine Republic fell through, for lack of adequate South American landing facilities, and left the huge craft without a buyer.

It is true that the ship would make a rather expensive, and a bulky, personal possession; it is 770 feet long, half again as large as the *Los Angeles*, America's one great airship, and carries one hundred passengers with ease.

Airplane Wings on Sailboat

LIKE an airplane in appearance is the novel sailboat seen here that can see-saw its way directly against the wind and just as easily can turn and ride with it. Before a group of eminent German engineers, its inventor, Friedrich



The German sailboat with wings like an airplane's, which catch the wind from any direction and transfer its power to the propeller.

Budig, of Berlin-Grunau, demonstrated how his queer craft could capture the wind's direct force to tilt the air vanes first to one side and then to the other, driving a propeller that pushes the boat forward. Pontoonlike keels that rock with the large planes strike the water and keep the craft from upsetting. The novel boat can be steered and turned around at will by the operator by altering the slope of the wing vanes.

A 7-Horsepower English Car

NOW England, too, is to have its flivver, according to reports. Recent secret tests of a new automobile of only seven horsepower—only a third of that of most American small cars—are said to have shown it capable of amazing speed and pick-up. Gasoline economy is also claimed for the midget car, shown at the left with an official of the concern that expects to manufacture it by quantity production methods. Wide doors emphasize the unusual body lines of the sedan model, which is shown in the illustration at the left.

Novel Use for Typewriter in Making Flexible Rulers

IF A ruler marked in tenths of an inch is not available, when such dimensions must be measured, it may easily be contrived with a typewriter. Many typewriting machines make ten spaces to the inch, and a paper rule is obtained by typing a row of periods, alternated with commas every tenth space to mark inches. Such a rule can be bent around shafting and other round surfaces. Some typewriters use twelve characters to the inch, so one must determine which sort he is using. Often a ruler in twelfths is serviceable; in that case a machine with twelve characters to the inch is used.

Auto Launches Lifeboat

RIGHT down to the water's edge backs a new lifeboat-launching auto invented in Germany. Its body tilts, and as the boat slides into the water a curved guide points it upward to prevent its



This newest German life-saving automobile rushes to the beach and launches the lifeboat, which glides on steel rails into the water.

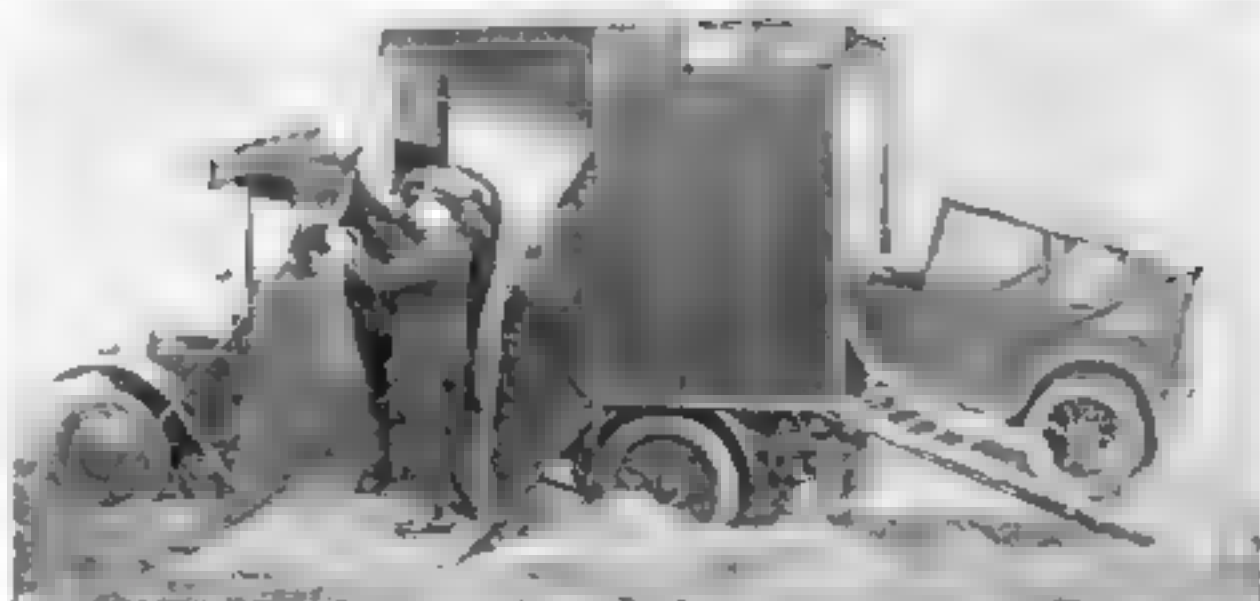
being swamped. With the speedy carrier which holds the craft on steel rails, a boat may be launched in a fraction of the time it takes to drag it by muscle power down a beach, and with less effort.

Asbestos Suits Worn in Fire

ASBESTOS suits are the latest style for firemen in Glendale, Calif., where the mayor and fire chief of the city recently gave them the hair-raising test seen at the right. Almost surrounded by flame in a small wooden shack deliberately set on fire, they fried an egg in the conflagration which nearly enveloped them. The suits saved them from injury, for the heat could not penetrate the thick mineral fiber.

Greater Power in Fire Boats

ADDITIONAL details concerning the speedy new fire boats put into service at Portland, Ore., and described in the JUNE POPULAR SCIENCE MONTHLY, have been supplied by A. D. Merrill, naval architect who designed the boats. The operating mechanism of each boat, including pumping units, propelling units and generators, can be controlled by one man from the pilot house.



A hunting innovation in England. A motor van carries the horses to the starting point of the meet. The huntmen arrive by auto, which occupies the van while the hunt is on. The sport ended the horses are returned to the van, which has followed the chase, and the sportsmen motor home.

In stating that three of the boats can concentrate 9,000 gallons of water a minute on a waterfront fire, the report was in error, Merrill says. Instead, each

boat has a rated capacity of 9,680 gallons a minute at 200 pounds pressure. Each is driven by two 305-horse-power gasoline engines, not Diesel engines as reported.

Dressing Ivory in Silver Coat

IVORY is given a silvery finish that actually is composed of tiny silver grains by placing it in a dilute silver nitrate solution, and then in a solution of common salt until it turns deep yellow. Next the ivory is dipped in water and exposed in the sun until it blackens. On rubbing, the black surface changes to a brilliant silver.



The mayor and the fire chief of Glendale, Calif., prove the value of new asbestos firemen's suits by frying an egg in a shack that is being consumed by the flames.

Automobile Van Aids Hunt

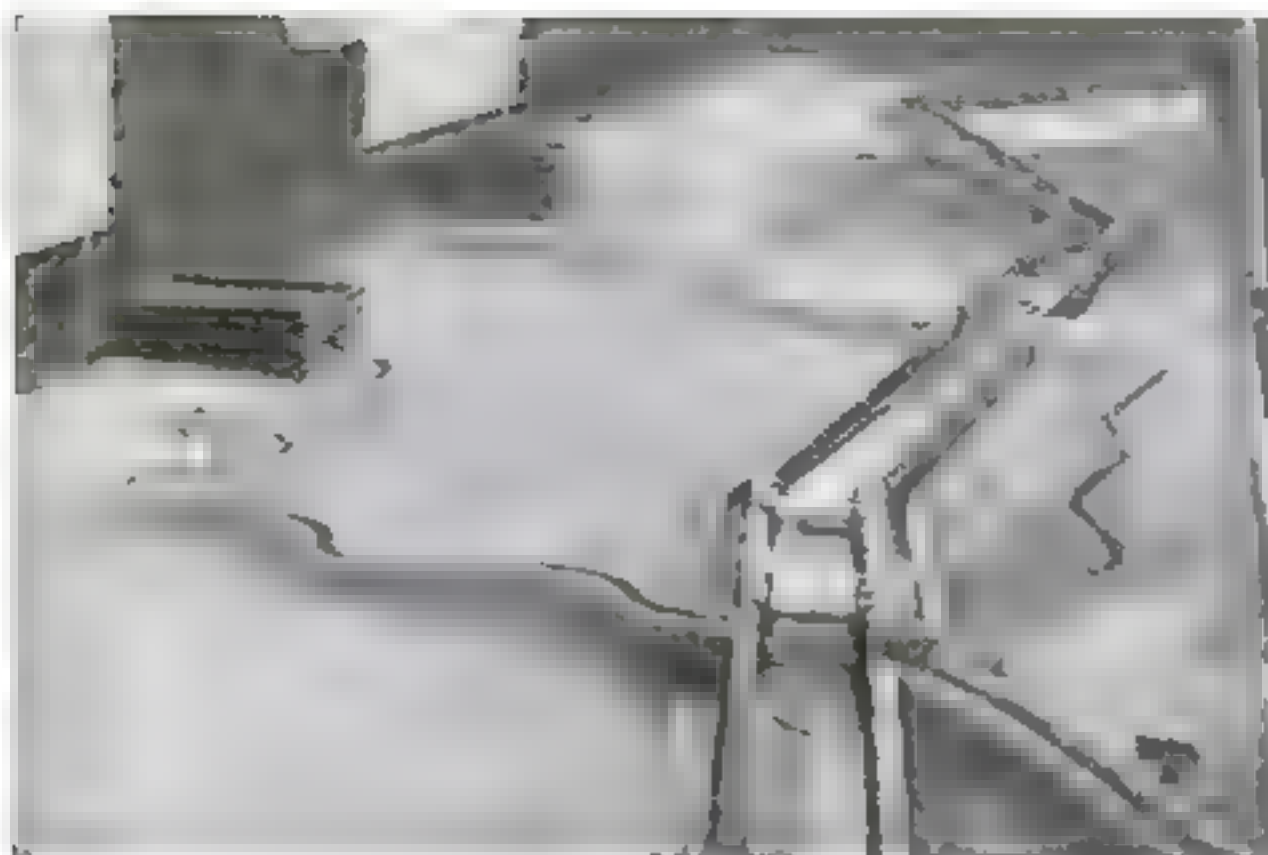
SERVING alternately as a portable double stall for huntmen's horses and a conveyance for their touring car, an ingeniously adapted automobile van makes hunting more comfortable for English sportsmen. The horses are brought to the meet by van, while the men go by car. As soon as the horses are brought out, the car is hooked into the van by a block tackle, and its groom-chauffeur follows the hounds as far as possible while the hunt is on. When the day's hunting is over the sportsmen return on horseback to the van leave the horses in the groom's care, back out their motor car and drive home comfortably.

Parachute Lands Airplane

THAT a huge parachute can land an entire airplane safely in case of motor failure was demonstrated again the other day at Tracy, Calif., in the latest of two years' experiments described from time to time in POPULAR SCIENCE MONTHLY. At an altitude of 2,200 feet, pilot E. J. McKeon shut off his plane's motor and went into a dive. The seventy-two-foot chute opened and checked the fall so that the landing was gentle. An unexpected complication occurred, however, when the plane, after landing, was dragged on the ground by its own parachute and somewhat damaged, indicating the need of some mechanism to release the plane from the parachute after the latter has served its purpose.

New Radio "Roof?"

AN ENGLISH physicist says he has discovered the existence of a second "radio roof." Fifty or sixty miles above the earth's surface experts believe there is a layer of electrified atoms of air gases underneath which the radio waves travel great distances, and through which they cannot penetrate. The new suggestion is that sometimes this "roof" dissolves and the waves reach a second layer possibly 150 or 200 miles high.



Model Tests Flood Control

TO DEMONSTRATE his plan for flood control, Carroll Livingston Riker, mechanical engineer, built this remarkable sixty-five-foot model of the Mississippi Valley and installed it in the basement of the Capitol at Washington, D. C. Rivers, valleys, and levees are shown in perspective. Running water tests in miniature the giant system of spillways by which Riker would divert flood waters into harmless channels and drain them off to the sea.

Blows Icebergs to Bits

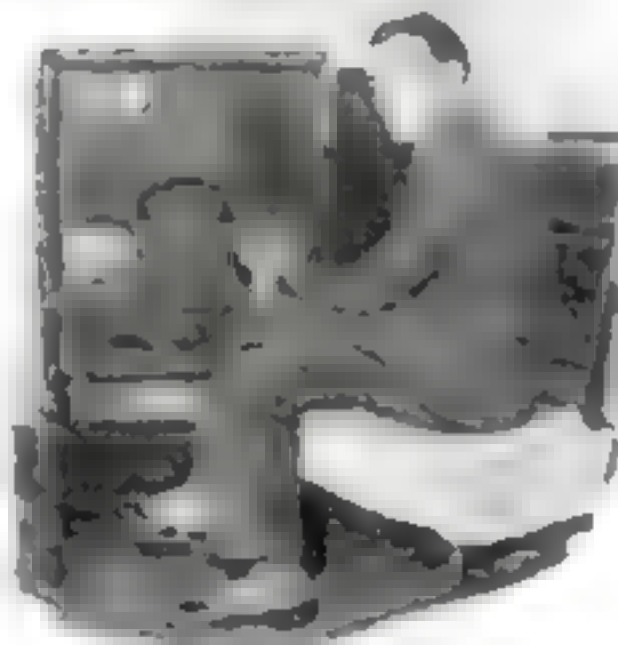
FROM time to time, POPULAR SCIENCE MONTHLY has told of the experiments of Howard T. Barnes, Professor of Physics in McGill University, Montreal, in breaking up ice jams by the use of thermit, the remarkable mixture of iron rust and powdered aluminum which, when ignited, produces terrific heat.

Now Professor Barnes, in a report to the Engineering Foundation, declares that the same process can be used effectively to destroy huge icebergs which menace North Atlantic shipping. Thermit, when properly ignited, produces a white-hot liquid steel at temperatures as high as 5,000 degrees F. Its action converts ice into gases so rapidly that an explosion results. In this way an iceberg can be split into small pieces.

Weed Mower for Railroads

HUGE sums that railroads pay to destroy weeds along their right-of-ways may now be avoided by the invention of a new mower on wheels, towed by a motor handcar. Pivoted cutter bars cut a six-foot swath on each side of the track while the car rolls along at the dogtrot pace of four miles an hour. A wider swath can be cut on a return trip.

Should the cutters strike an obstruction, the mower automatically uncouples from its towing car and stops without damage. Since the cutters may be swung up or down by the operator, the device is said to be equally effective on level prairies and on the steep sides of banks.



The automatically tuned radio receiver. The set of control buttons, each of which instantly brings in a certain broadcasting station, is seen in the right side of the cabinet at the bottom.

Tells How to Remember Names and Faces

WHAT was your most embarrassing moment? Wasn't it the time you started to introduce a friend to a man you had met a moment before—only to discover that you had forgotten the latter's name?

Dr. Donald A. Laird, psychologist of Colgate University, has been studying ways to avoid this predicament. And he has worked out a series of mental exercises for remembering names and faces. Here are some of them.

Every evening sit down and recall the names and faces of all persons you have met during the day.

In periods of five minutes, practice repeating as many names of acquaintances as you can recall.

Practice recalling the names of characters in books you have read.

Ask a friend to call out the names of persons, and see how quickly you can respond with a description of each person.

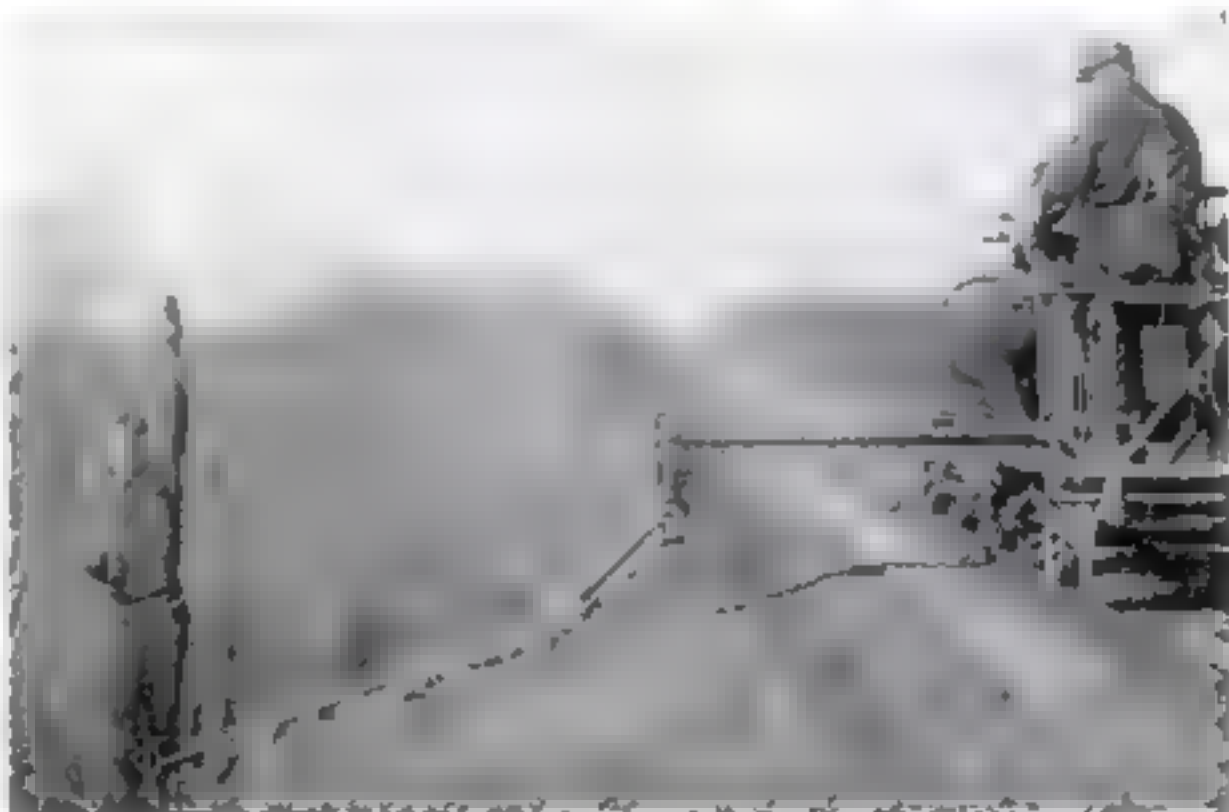
Whenever you are introduced to a stranger, make the practice of associating the meaning of his name with some object—as Mr. Pitt with pits. Or associate the name with some circumstance or character—as Mr. Scott, the automobile salesman, with the story of the Scotch automobilist who took so much free air that he blew out a tire.

Remember a name by the arrangement of its letters; for instance, the three e's in Greene.

Press Button to Tune-In

IT ISN'T any trick at all to tune-in your favorite broadcasting station with the new receiving set pictured at the left. All you need do is press a button; automatically the dials leap to the correct positions and in comes music.

Previously the receiver has been tuned to the station in the ordinary way and an adjustment tightened. Thereafter the station may be recalled at any time merely by touching the automatic control for that particular station.



Towed by a motor-driven handcar, the mower proceeds along the track cutting weeds in a six-foot swath on each side. The angle of the cutting arms is adjusted by the operator to the slope of the bank.

Mouse Traps Camouflaged as Corncobs and Cans

CAMOUFLAGE—which helped win the war—is helping catch mice, according to a recent report of the United States Biological Survey at Washington. The latest traps are designed to deceive the most wary rodent. One, built for mice that rob corncribs, looks like a hollowed-out corncob and has its death-dealing spring hidden in the center. In another, designed to fool mice that chew papers in your desk at night, the spring is shaped like a harmless paper clip.

An old tin can with its top partly mashed in is another. But when the inquisitive mouse jumps inside, he finds that the top springs shut with surprising quickness, leaving him locked within.

Still another is a trap that catches mice all night, automatically resetting itself. A metal door drops shut on the heels of the investigating mouse and in seeking a way out the prisoner follows a passage that suddenly shoots him into a half-gallon can filled with water. The mechanism is so constructed that the plunge of each victim resets the trap for the next mouse.

Making Phone Speak Up

A LOUDSPEAKER for your telephone now is available in the form of the portable amplifying unit pictured at the right. It is readily attached to any type of instrument. Although originally intended to make telephone conversations easier for persons with defective hearing, it is also useful in a noisy office where listening is difficult.

For the loud-speaking earpiece which is provided, a horn type of speaker may be substituted if privacy is not desired, leaving both hands free to take notes and handle papers.

The amplifying unit includes a special audio transformer with standard radio tubes and batteries. The volume of sound is regulated by turning a knob control.



Using the loud-speaking telephone. The amplifying unit, which uses radio tubes and batteries, is in the cylindrical cabinet at right.

Kite Does 300 Loops

THREE hundred loops in six minutes and thirty seconds! A homemade kite flown by Gustav Wilkoski, a fifteen-year-old Minnesota boy, recently set this world's record in a contest at St. Paul.



Toys Teach Housebuilding

A TOY with a valuable educational purpose is a housebuilding set for youngsters that has recently been placed on the market by a member of the National Committee on Wood Utilization.

To the boy who plays with it, the set, with its tiny sills, beams, joists, and rafters, some of which must be cut to size, affords limitless fun in constructing lifelike dwellings in miniature. Its ultimate aim is to teach young America to distinguish between good home construction and bad. Then, according to the committee which sponsors the idea, they will be in a better position to escape the wiles of slipshod housebuilders and insist upon correct and efficient utilization of wood in their future homes.

World's Biggest Bird Cage

THOUSANDS of rare birds will occupy the world's largest aviary, nearing completion on Catalina Island, Calif. It is soon to be open for public exhibition and scientific research. Already live specimens from plains, mountains, and tropical jungles are arriving daily. All kinds of wild fowl will be propagated in the breeding pens.

The immense bird house is being built as a civic enterprise.

Sounds That Climb Highest

RECENT tests show that the crowing of a rooster, the ringing of a church bell, and, under some conditions, the shout of a man penetrate almost a mile into the upper air.

A cricket's chirp carries up 2,500 feet, and the croak of a frog can be heard at an altitude of 3,000 feet. Among sounds produced by living things, a dog's yelp holds the altitude record. It has been heard by balloonists 3,900 feet up. The report of a rifle will carry about the same distance.

Of all sounds recorded, a locomotive whistle reaches highest. It has been heard more than two miles above the earth.



The gigantic bird house that is nearing completion at Catalina Island, California. Here thousands of rare and beautiful specimens of wild birds from all parts of the world will be housed and bred.

Earthquake Telegraphs the News of a City's Doom

HOW an earthquake telegraphs a message of destruction far in advance of human communication is disclosed by official records of the quake that recently wrecked the city of Philippopolis, Bulgaria. At the instant the quake struck, seismographs all over the United States penned their record. From observatories where the instruments were housed, readings were telephoned to Washington, D. C., as fast as they could be deciphered.

Experts of the U. S. Coast and Geodetic Survey combined them and plotted off the apparent center of the disturbance on a map. Their lines crossed squarely upon the doomed city of Philippopolis. Three days later, over repaired Bulgarian telegraph lines, came word that Philippopolis had been wiped out.



Photos in Natural Colors

JUST arrived in the United States is Joseph Darbel, French inventor, seen above with his ingenious new camera to take pictures in natural colors. In reality it takes three pictures simultaneously, through a single lens. Each records one of the three primary colors from which all tints of a scene are blended. In order to do this, three separate film- or plate-holders are provided, and inside the camera's body is a set of mirrors and filters to separate the colors.

When the pictures are developed, a transparent print in its proper color is made of each. The three, combined, give a single photo in natural colors.

Colds Are the Costliest

COLDS and bronchitis are the most prevalent ailments in America. Influenza and gripe come second.

These statements come from Dr. Hugh S. Cumming, Surgeon General of the U. S. Public Health Service, after two years' investigation. Respiratory infections cause more lost time in industry than any other group of diseases.

Huge Reflector Sends Beams of Radio



This odd structure at Nauen, Germany, is a new type reflector for beam radio transmission.

SOMETHING new in "beam radio" is a remarkable reflector for radio waves being tried out at a Nauen, Germany, transmitting station, in experiments in "pointing" a radio beam at one particular receiving station. This method conserves power and makes secret communication possible without the necessity of a code.

In other beam radio stations, the reflector is a curved row of vertical wires behind the transmitting aerial, but the Nauen experimental station stretches the reflecting wires over a horizontal frame as shown above.

Puzzle in Auto Lights

REMARKABLE inconsistencies in auto lighting laws among various states are revealed in a chart recently compiled by engineers of the National Lamp Works, Cleveland, O., which is seeking a uniform lighting code.

The distance a car's headlights must be visible varies from seventy-five feet, in Delaware, to two hundred feet in seventeen other states. Though red tail lamps are the usual rule, you may use yellow in four states and green in Wyoming.

More Powerful Than TNT

ALTHOUGH his new explosive "radium-atomite" is many times more powerful than TNT or nitroglycerin, Capt. H. R. Zimmer, of Los Angeles, handles it as if it were so much flour. A former Army officer, he developed the remarkable invention in his outdoor laboratory. His new green powder, recently tested before military officials, contains radium. It is safe to mix, for it requires a spark to set it off.

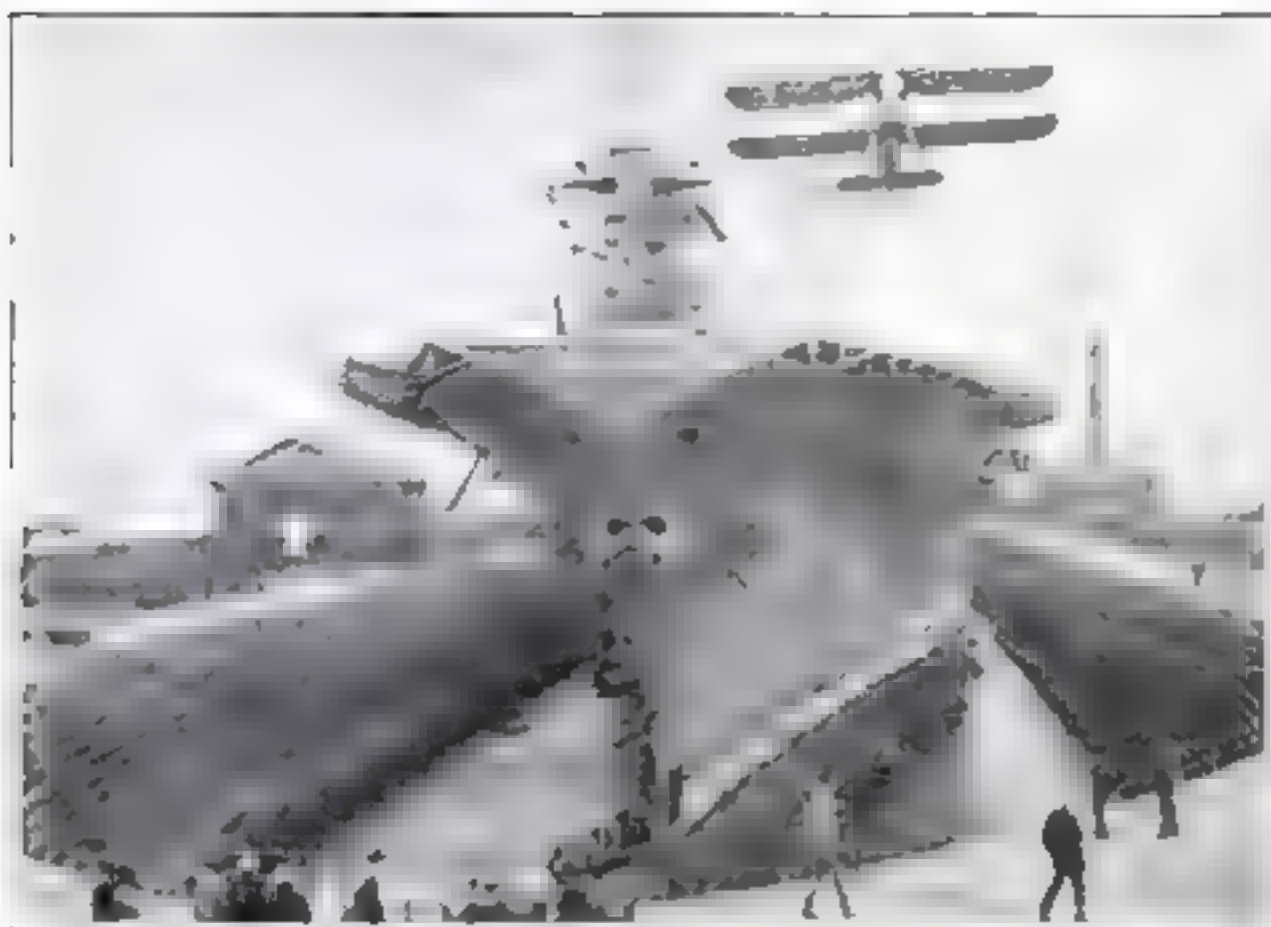
Hunt Mysterious Element

ONE of these days a new element may be added to our list of known ones, all but bringing it to completion. A mysterious, unidentified radioactive element, much more potent than uranium, radium's parent, exists on earth and releases quantities of energy, Prof. Walther Nernst, of the University of Berlin, recently told the Franklin Institute at Philadelphia. Another expert, Dr. Charles F. Brush, inventor of the arc light, declared his belief that recently-hardened steel, and also silicate of cobalt and other chemical compounds, contain it.

Chemists say there are ninety-two simple substances, or elements, of which all things are made. Ninety now are known, ranging from hydrogen, the lightest, to uranium, the heaviest. Two blank spaces in their list, for the unknown elements No. 85 and 87, fall in the group of radioactive substances with radium and its ray-producing cousins.



Capt. H. R. Zimmer, inventor of the new explosive, at work in his outdoor laboratory. His apparatus consists of a few crocks, a small bicycle tire pump, a siphon, and an ice cream freezer.



New Plane Carrier Sets Speed Record

ON HER recent voyage from San Pedro, Calif., to Honolulu, 2,228 nautical miles, the U. S. Navy's new aircraft carrier *Lexington* shattered all records, doing 700 miles the first twenty-four hours, 742 miles the second, and 788 miles in the remaining twenty-four hours and thirty-four minutes. The average speed was 30.7 knots an hour. Since then the craft, with defective turbine blading perfected, has made 33.04 knots. The light cruiser *Omaha* held the world's twenty-four-hour record, 690 miles, and the distance record—2,091 miles from San Francisco to Honolulu in seventy-five hours, forty minutes, and forty seconds.

Cancer Cost Near a Billion

LAST year cancer caused a loss of \$800,000,000! That is approximately what 300,000 workmen would lose if they were out of jobs for a year.

This estimate comes from Dr. Louis I.

Dublin, statistician of the Metropolitan Life Insurance Company. And he predicts that the loss will be even greater for the present year. Cancer is steadily increasing, despite all efforts of science to stop it.

Of the total \$800,000,000 loss, Dr. Dublin says, \$680,000,000 represents the money value of persons who died from the disease. This is equal to one-tenth of the value of all the iron and steel manufactured in the United States. The remaining \$120,000,000 was the amount of money which was spent in caring for the victims.

Haven for Planes

FLOATING concrete islands capable of being navigated from place to place like ships, by means of their own propellers, are the latest French idea in ocean landing fields for planes. The novel "aerports," of which a model was recently exhibited by the Chamber of Commerce of France, would be seaworthy enough, it is claimed, to take up stations as halfway stops in transoceanic flights. Planes would land upon them for refueling and take off with the aid of catapults resembling those used at present for launching planes from warships.

The islands would have hangars and living quarters for permanent crews of mechanics, according to their inventor, Charles de France; and two giant 2,500-horsepower motors would propel them to their location.

Inventor Makes Wheels Spin the Right Way in Movies

MAKING whirling automobile or carriage wheels look natural on the screen—a twenty-year puzzle of the movies—has just been solved. Because movie cameras could not keep pace with the rapid flashing of the spokes, wheels often appeared to revolve backward.

Now John Nickolaus, laboratory head of the Metro-Goldwyn-Mayer studios, has discovered that he can keep wheels spinning the right way by painting out groups of the spokes. He applied dark paint to four sets of two spokes each on a buggy wheel, painted in light color the intervening spokes, and successfully photographed the wheel at all speeds.



Free Shower of Perfumes

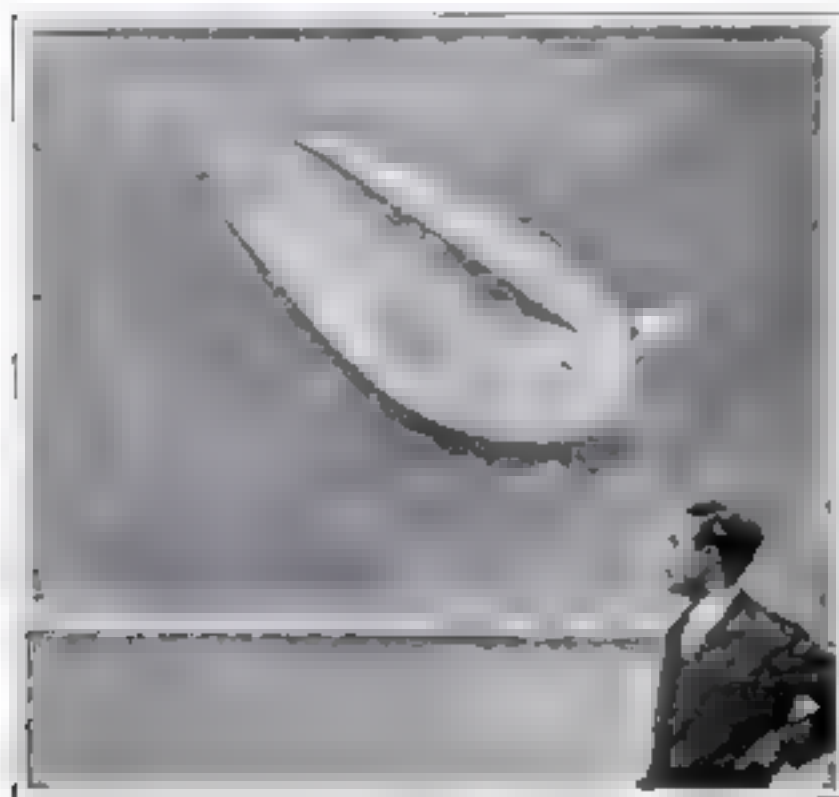
TO ADVERTISE his wares, a German merchant of perfumery and toilet waters sprays with perfume all passers-by free of charge, and even scents the air in front of his shop.

From the top window of his store a little hose, seen in the picture above, shoots forth a shower of the merchant's different brands of perfumery, and the window shopper can sniff the air and make his choice from the sample before he goes in to buy.

Many Frogs; Prices Drop

BULLFROG hunters in the marshes of Louisiana have been making such big catches of late that there are more frogs now than there are people who enjoy the delicacy of their fried hind quarters. As a result of this overproduction, the market price of the croakers recently dropped to a low level—about half the price of dressed chicken.

Louisiana supplies the rest of the world with some two million frogs a year.



Model of the new concrete type of floating landing field for airplanes, designed by a French inventor. It is driven by propellers. Hangars for planes and crews' quarters are provided.

This Photographer Harnesses Sunlight



After taking out of focus of a subject, the woman who is the popular subject, the sunlight reflector is used to direct the light with its inventor.

SUNLIGHT reflected into his studio by a huge movable reflector is used by a California photographer in making enlargements.

The reflector, shown in the picture below, is made of aluminum, painted metal over a wooden frame. It is tilted to proper position by ropes operated from the side of the studio, and the rays are directed through a window on the side shelf of which the enlarging apparatus is mounted.

The inventor, Capt. Lee N. Passmore, of San Diego, rigged up the apparatus for his backyard studio, which had been without sufficient light.



No More Lost Golf Balls?

GOLF balls that figuratively call "Yoo hoo, here I am!" when they get lost in the "rough" are promised by a New York inventor. They depend on the player's senses of smell, hearing, and sight to help him discover them.

One plan is to coat the balls with the fireworks composition commonly called "spit devil." When the club strikes the ball the explosions begin. They continue for some time after the ball has come to rest, so that the golfer can hear the spitting of his ball in the grass and so be guided to its hiding place.

Another suggestion is the application of a solution of phosphorus and carbon bisulphide. In the deep grass the ball would have a glow that would attract attention. Another method is the coating of the ball with a paste containing chemicals which when wet emit a gas. When a ball so coated falls into the grass, the moisture near the ground causes a chemical reaction and the vapor arises. This puff can be seen by a searching player. Various aromatic liquids may be used to soak the balls so when they get lost golfers can find them by walking along sniffing the air near the ball's supposed location.

What Is Your Question?

POPULAR SCIENCE MONTHLY is glad to answer, whenever possible, readers' questions on any subject within its field, and to supply names and addresses of makers of devices described in the magazine. A stamped and self-addressed envelope should be inclosed.

Uncle Sam Runs a Still

UNCLE SAM has turned to the bootlegger's equipment in experiments, under direction of the Prohibition Bureau, to develop a nonpoisonous denaturant for alcohol. The business of the Government's still, pictured at the right, is to do the same thing that the bootlegger does—take the poison out of denatured alcohol, but at the same time to make it disagreeable to the taste. The still is used in submitting prospective formulae for a harmless denaturant to severe tests.

How to Wheel a Barrow

SEVENTY bricks in a wheelbarrow, pushed at a brisk pace, are easier to wheel than fifty bricks in the same barrow trundled at a slow walk. The British Industrial Fatigue Research Board has come to this conclusion after tests.

Large rubber bags were attached to the backs of men wheeling varying weights at different speeds. The gases expelled from their lungs were collected and analyzed by chemists for carbon dioxide content. The result showed the amount of energy used during each test.

It was found that a slow walk required almost twelve percent more energy than a faster one, and that the least average expenditure of energy came from wheeling bricks at a brisk walk.

Know Your Car

IF THE engine of your car unexpectedly overheats while you are driving, the trouble may be due to any one of a number of causes. The first thing, of course, is to make sure there is enough oil in the crank case and enough water in the radiator. If so, then look for a slipping or broken fan belt. Often a broken belt can be pulled together and tied with a stout cord, which will hold until you get to the next service station, where you can get a new belt.

Look next for a clogged water pipe or loose hose connection. You can tell whether the water pump is working by motion of water in the radiator.

A more serious trouble, and one which hardly can be remedied on the road, is a worn timing chain which, by slipping, may retard the spark and make the engine overheat. That is a job for the repair man.

29,000,000 Go to School

ACCORDING to the Federal Bureau of Education, American college students number more than those in all the other countries combined. They total about 1,000,000, those in the rest of the world, 950,000. In schools of all kinds, 29,000,000 students are enrolled in the United States. This is more than one fifth of the world total.



G. F. Beyer, Chief Chemist of the Prohibition Unit, at work with the Government still to concoct a nonpoisonous, bad-tasting alcohol.

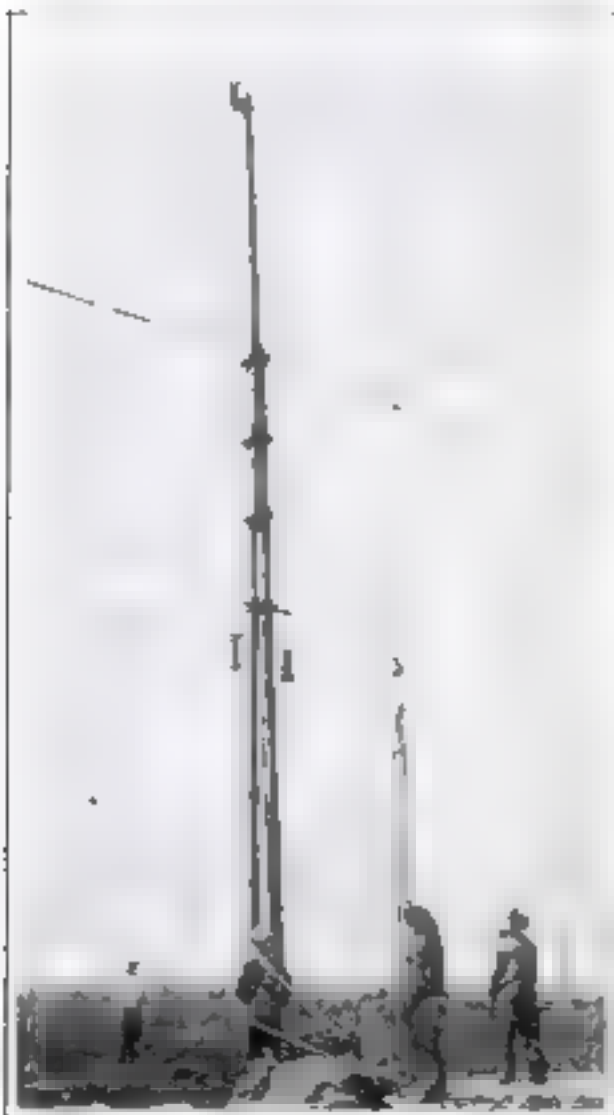
How Much Do You Know of the World You Live In?

TO TEST your knowledge, see how many of these questions you can answer. Correct answers are on page 136.

1. Where was the first oil well in the United States?
2. Where are the largest stones ever used?
3. Where is the Great Barrier Reef?
4. What people wear socks divided for the big toe?
5. Where do fish live in dried river beds?
6. Are there places where no plants will grow?
7. Where does asbestos come from?
8. What city is called "Paris of the East"?
9. What has much to do with coconut?
10. What are the youngest mountains in the world?
11. Where do the "white Indians" live?
12. What is the oldest town in America?

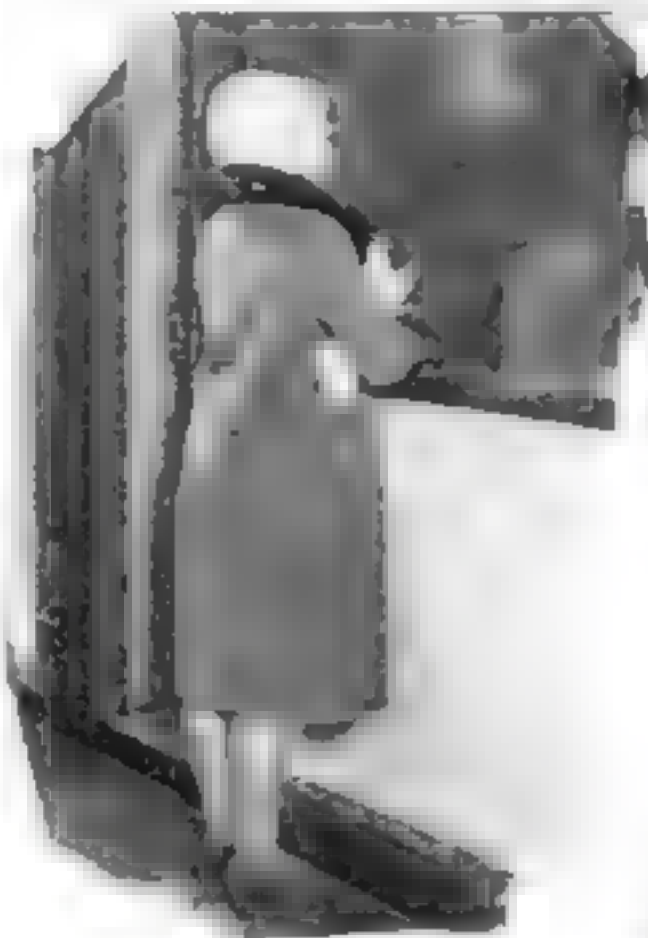
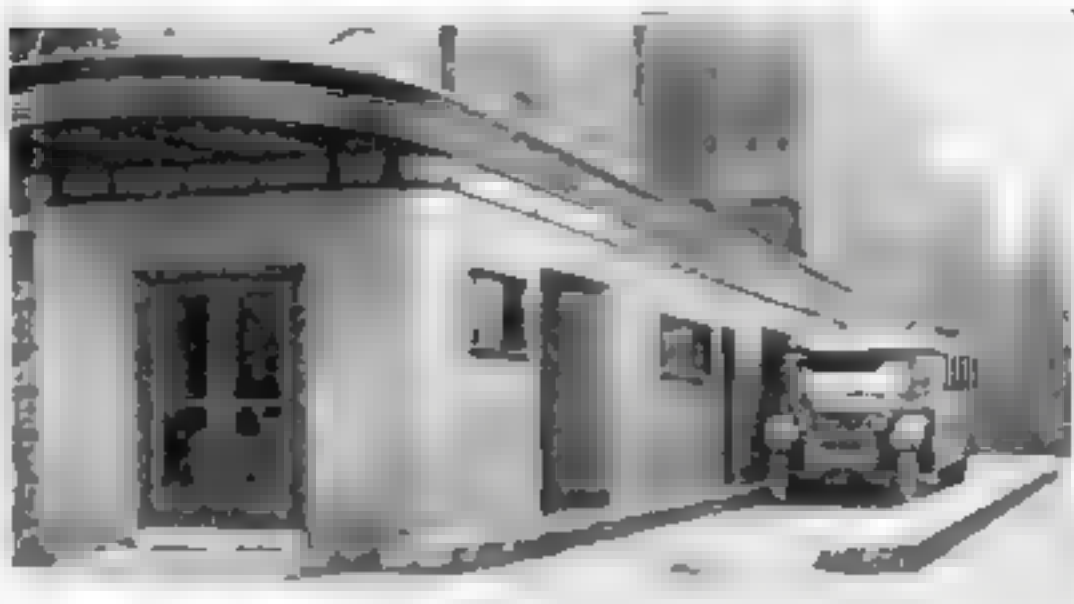
Room for Millions More

PROF. H. L. SHANTZ, of the University of Illinois, recently told the National Academy of Sciences that the earth is capable of supporting 8,000,000,000 people, if all the land is fully utilized. This would be nearly five times the present population of the world.



The new beam radio transmitting station at Rocky Point, N. Y., showing system of vertical wires that serves as reflector for radio waves.

Large Terminals Built for Bus Lines



TRAVEL by motor bus has reached such proportions in the East that fifty-four interurban lines now operate into New York City, and the city is preparing to erect terminals similar to modern stations to accommodate the traffic.

These terminals are complete, with waiting rooms, restaurants, rest rooms, telephone and baggage service, ticket shops, news agency shops. They are centrally located, the one shown above being at the foot of a leading New York Center.

At the left a prospective passenger is seen in the new terminal reading a timetable, and viewing the destination points of the bus lines.

World's Largest Building

A BUILDING so big that the plumbing and wiring will be measured by mileage rather than by footage is being constructed in Boston. It will cost \$21,000,000, cover 110,000 feet of ground space, and be the largest building in the world. It will surpass in floor area such famous structures as the General Motors Building in Detroit and the Graybar, Telephone, and Equitable Life buildings in New York. The construction will be completed within a year. The permanent population of the building will be nearly that of a city of 25,000.

Ten acres of the floor space will be occupied by a huge department store, which will be connected with a distant warehouse by an underground tunnel through which electric trucks will transport goods as needed in the store. Parcels for delivery will be sent to the warehouse, which will become the delivery center. The building also will be connected with the Boston subway system by a tunnel two blocks long.

Five stories above the department store will be reserved for a permanent exhibition of New England industrial products. Above this, offices will occupy the building to the top of the central tower, which a municipal height-regulating ordinance limits to 300 feet. There will be three basements. One will provide parking space for between 3,000 and 5,000 automobiles. The owners will drive in, leave their cars, and ascend in elevators to the store or offices above.

The huge structure will be known as the New England Building.

But Not Exactly a Relish

THE Borgias and other notorious poisoners of history were reputed to have mixed finely powdered glass in food and drinks which they offered their victims. Recently, however, Dr. Roche Lynch demonstrated to the Medico-Legal Society of London that this supposedly murderous material usually passes through the human digestive system without causing death or even doing serious damage. Larger pieces of glass with sharp edges, however, are dangerous.

A Giant Radio Reflector

AT ROCKY POINT, N. Y., there has just been erected what is said to be the most efficient type of beam radio transmitter yet installed. Outstanding features are its simplicity and the efficiency with which it directs a pencil of radio waves toward distant receiving stations, resulting in economy of power and high-speed transmission.

From ordinary radio broadcasting stations, radio waves spread out in all directions, and most of the energy used up is wasted. The new system uses a system of auxiliary wires to serve as a reflector for the waves and focus them in a beam.

Popular Science



SUMNER BLOSSOM, Editor

RAYMOND J. BROWN, Managing Editor
ARTHUR WAKELING, Home Workshop Editor
ALFRED P. LANE, Technical Editor
EDGAR C. WHEELER, Associate Editor
ISRAEL DOSKOW, Art Editor

Published Monthly by Popular Science Publishing Company,
Inc., 250 Fourth Avenue, New York City. In the United States
and its Possessions and in Canada \$2.50 the Year. In All Other
Countries, \$3.00 the Year.

The Kite String of Dreams

FIVE years ago, almost to the month, Rear-Admiral William A. Moffet, Chief of the Navy Bureau of Aeronautics, wrote a remarkable prophecy for *POPULAR SCIENCE MONTHLY*. He predicted giant air liners "of 5,000,000 cubic feet capacity, equal in size to the steamship *Leviathan*."

He saw "airplanes carried on them as are lifeboats on ocean-going vessels. These planes," he said, "could land on a deck on top of the airship and be launched from it, carrying passengers for wayside destinations. Imagination—but not too much of it" was his significant comment.

Today his vision is coming to pass. The Navy's two new giant dirigibles, each of 5,000,000 cubic feet capacity, will be built as aircraft carriers, almost exactly matching the description in *POPULAR SCIENCE MONTHLY* five years ago.

Writers for *POPULAR SCIENCE MONTHLY* are men of vision, never visionary. Every step in progress is born of imagination. The growth and influence of this magazine has been measured by a capacity to look beyond the horizon. But between idle dreaming and sound, practical imagination there is a vast difference.

A kite sailing in the clouds at the end of a long string. That represents imagination—the valuable kind. No matter how high it flies, it is still connected with the solid earth. As soon as imagination loses touch with fact it drops in value, as a kite flutters down the minute its string breaks.

We thrill at the glimpse of a future goal. We glory in visions come true. An inspiring rule for successful achievement are Moffet's own words: "Imagination—but not too much of it."

Hail to the "Coffee Johns!"

THE other day a hot-dog wagon took its place in the Ford Museum in Detroit beside the first Model T and the ten millionth car.

"Coffee John" used to own that wagon and Henry Ford used to eat there when he was a mechanic. Across its counter Ford outlined his plans for a "horseless carriage" to the sympathetic owner, and "Coffee John" lent the money that carried the struggling company over a crisis.

Delve into the history of almost any great company and you will find a "Coffee John" who boosted at the right time. Too frequently they are like Lawrence, the designer of Land-bergh's engine, who, when asked why he was so reticent, remarked, "Who ever heard of Paul Revere's horse?"

To the Ends of the Earth

WATER, dipped from the spot where Washington crossed the Delaware, christened Commander Byrd's monoplane. Had any of those drops swirled under Washington's boat?

Probably not. That water had flowed to the ends of the earth. Circulation of water, like circulation of the blood, carries away impurities. It keeps our planet healthful.

Circulation of a different sort is the great gift of science—circulation of people and ideas. And the speed with which people may be transported and ideas communicated is the greatest development of the Twentieth Century. To prove this, just recall that it took months for the news of the Peary Polar expedition to reach the public, while Nobile was in almost constant communication with the world. Millions followed on their radio sets the news of his rescue from the Arctic wastes.

Fame at the Doorstep

IT TOOK fifty centuries for the eye of a needle to move two inches, from the head to the point. Then Elias Howe's idea made possible the sewing machine and freed women from the drudgery in a task that dates back to the Bronze Age.

Starting with cave men who used splinters of bone, human beings had held needles in their hands day after day for thousands of years. Yet none had seen the revolutionary idea lying so close.

What idea, just as simple and just as important, will we overlook day after day in the year 1928? Perhaps there is a hint on page nineteen. Fame and fortune await the man who can find new uses for sulphur, or an economic substitute for tin.

Two Experiments

ATEN-YEAR-OLD boy at Camden, N. J., found a spike along the railroad. He put it on the track "to see if the big engine would flatten it out like it does a penny." The big engine didn't. A passenger train was wrecked, the fireman and engineer badly burned, and \$450,000 worth of damage done.

The same day, officials of the Bureau of Standards made another experiment. They set fire to a condemned Washington, D. C., building, as told in this issue, after placing recording instruments on every floor. These instruments disclosed what happens within a burning building and the effect of the heat on other fixtures.

Experiments are worth while only when they contribute something to our store of vital, useful knowledge.

Why not Keep Cool?

AT THE University of Michigan experiments are being made with devices to keep houses cool in summer. Much effort has been spent on methods of keeping houses warm in winter. As a result, we have oil burners and central heating plants, hot water and steam—any number of heating systems.

Experiments with hundreds of individuals indicate that sixty-eight degrees Fahrenheit is the most comfortable and most beautiful temperature. But it is surprising how little Yankee ingenuity has been applied to the problem of keeping our homes at that temperature in midsummer. Those experiments out at Ann Arbor are worth watching.

"Let Them Say!"

"I DO not see why a submarine should not make a voyage from Spitzbergen to Alaska."—Capt. George H. Wikma, trans-Polar flyer.

"The porpoise, a stupid animal, has a larger brain with more convolutions than man."—Dr. O. R. Langworthy, Professor of Anatomy, Johns Hopkins University.

"Milk without cows will be the next short cut of science."—Alfred King, English sanitary inspector.

"Alcoholic liquors are harmful to persons bitten by venomous snakes."—Afranio do Amaral, director, snake serum farm, Butantan, Brazil.

"In time we won't have to race ninety miles an hour to get off the ground in an airplane."—Henry Ford.

"Four thousand planes will be built this year and twice as many could be sold if they were obtainable."—Clarence M. Young, Director of Aeronautics, U. S. Department of Commerce.

"What we need is an electric push button system so passengers can open car windows without a crowbar."—J. J. Tetum, Baltimore, to members of the American Railway Association.

Below: The vertical lift bridge in course of construction over the Koningshaven, Rotterdam, Holland. The sixteen **SKF** Spherical Bearings in the giant cable sheaves at the top each sustain a load of 165,345 pounds. 272 **SKF** Ball Bearings of various types are used throughout. The thrifty Hollanders appreciate that "nothing is apt to cost so much as a bearing that cost so little." In the inset, a close-up of one of 16 **SKF** Spherical Bearings in a cable sheave.



Spanning the Flood at Rotterdam with 288 **SKF** Bearings

IT'S a far, far cry from the new vertical lift bridge over the Koningshaven at Rotterdam, but there's a story behind it that echoes wherever anti-friction bearings are used—even on *this* side of the Atlantic.

For this great structure raises and lowers its lifting span with the help of 288 **SKF** Anti-Friction Bearings.

Sixteen **SKF** Spherical Bearings, the same that 45 American railroads use in passenger car journals, are in the giant sheaves atop the lifting towers.

Two hundred and seventy-two **SKF** Ball Bearings of various types—depending upon the service required of them—are distributed among the guide pulleys, the buffer sheaves, the guide rollers and other working parts.

For **SKF**, making practically *all* types of bearings, is *able* to put the right bearing in the right place *always*.

SKF INDUSTRIES, Inc., 40 East 34th St., New York City



SKF

The
Highest Priced Bearing
in the World



Why "Fix" a Brand-New Car?

Gus Gives a Know-It-All Driver a Few Hints Concerning His Automobile That Are Worth Anybody's Reading

By MARTIN BUNN

"ISN'T it funny," observed Joe Clark, "that just as soon as a fellow gets to know a little about automobiles, right away he thinks he knows it all?"

Gus Wilson, his partner, working on a motor outside of their Model Garage, grunted. "Know-it-alls give me a pain," he growled.

"Then," grinned Joe, "you're due for a severe pain. Here comes the biggest know-it-all in town, Archibald D. Green!"

A large and shinningly new sedan stopped with a crunching of gravel and a fat young man climbed jauntily out. "Hello, old-timers!" he called. "Just thought I'd let you feast your eyes on my new boat. Some class, eh? And believe me, those factory men don't know a thing. It took me two or three hours to get it running good. The carburetor wasn't set just right. I had to go over the ignition system—even the brakes were set wrong!"

Green, thumbs hooked in his vest, strutted around like a pouter pigeon.

"It's a good looking bus, all right," observed Gus with a twinkle in his eye, "and I guess you can show 'em up when it comes to fixing an automobile."

"Surest thing you know," Green agreed, nearly snapping the buttons on his vest. "Nothing can happen to a car that I don't know how to fix and fix right."

"KIND of fancy yourself as an auto mechanic, don't you?" Gus growled. "Why, I'll bet you I can fix your car with my bare hands and without busting any part, so you'll have to hold on for help."

"Huh!" Green snorted. "Here's a good cigar that says you can't!"

"All right," said Gus. "Just suppose you're out on a lonely road and a tire goes flat." He screwed the valve out of one of the rear tires and it collapsed.

"What the heck is this, a joke?" puzzled Green. "If you just wanted to see me change a tire, why didn't you say so in the first place?"

Disgustedly, he got out his jack and attempted to put it under the rear axle, but the top of the jack was at least an inch too high to slip under. The collapse of the big tire coupled with the small diameter of the wheel let the axle down too far. A look of dismay rapidly replaced Green's disgusted expression.

"You're sure some swell auto mechanic if you let a little thing like that stump



"What is this, a joke?" puzzled Green—but the jack was too high to slip under the axle and a look of dismay rapidly replaced the disgusted expression on the face of the know-it-all.

you," grinned Gus derisively. "Hand me that cigar and I'll show you a few ways to raise your car."

"Now," said Gus as he clipped the end from the cigar Green handed him, "what's the matter with digging a hole for the base of the jack? And there's certainly nothing to stop you from placing the spare tire in front of the flat and driving the flat up on top of it. Then you can slip your jack under. If you haven't any spare along, you can run the car up on a piece of wood."

"And just a minute," called Gus as Green was about to climb into his car. "You said you had to adjust the brakes. What was the matter with 'em?"

"Nothing much," Green replied. "The car didn't seem to stop as quick as I thought it should with four-wheel brakes, so I just tightened 'em up."

"I thought so," grunted Gus. "See what happened when you stopped here." He pointed out where both wheels on one side had locked and slid a few inches in the gravel although the wheels on the opposite side had left no mark.

"WHEN the four-wheel brakes on one side are too tight you are all set for some extra fancy skidding."

"If you want to get the brakes even, you've got to jack up both rear wheels at the same time and have somebody put on the brakes while you test to make sure that both brakes take hold at the same time. If you haven't anyone to help you, rig up some blocks of wood and use your

jack to push the brake pedal down a little at a time."

"And," Gus continued, "you can pull on a husky spring balance hooked into the spokes near the rim to match the effect of one brake with the other. That is a really accurate method."

"THEN when you have the rear brakes right, remove one jack and raise a front wheel and test it. The front brakes should take hold a little after the rear ones and they shouldn't hold so tight. If they lock before the rear ones, you are mighty liable to get into a dangerous skid. After you have one front brake right, you can transfer the other jack to the front and match the other front brake."

"Why not just shorten the brake rods by turning the clevises?" suggested Green.

"Whatever you do, don't do that!" Gus replied most emphatically. "Don't ever monkey with the length of the brake rods. Changing their length throws the leverage of the whole system out of whack so that you'll have to push a whole lot harder on the brake pedal to get the same amount of braking effect."

"Can you fix 'em for me this morning?" asked Green, sheepishly.

"Soon as I finish this job I'll get at it—by the way, didn't I hear you say you had adjusted the carburetor?"

"You did," Green admitted.

"Then," grinned Gus, "I'll fix that too!"

**A Radiotron
for every purpose**

RADIOTRON UX-201-A
Detector Amplifier

RADIOTRON UV-196
Detector Amplifier

RADIOTRON UX-190
Detector Amplifier

RADIOTRON WD-11
Detector Amplifier

RADIOTRON WX-12
Detector Amplifier

RADIOTRON UX-285-A
Detector Only

RADIOTRON UX-191
Power Amplifier Last
Audio Stage Only

RADIOTRON LX-227
Screen Grid Radio
Frequency Amplifier

RADIOTRON UX-113-A
Power Amplifier

RADIOTRON UX-171-A
Power Amplifier Last
Audio Stage Only

RADIOTRON UX-213
Power Amplifier Grids

RADIOTRON UX-340
Detector Amplifier for
Broadcast-reception
Applications

RADIOTRON UX-286
Power Amplifier

RADIOTRON UX-223
A.C. Filament

RADIOTRON UV-227
A.C. Heater

RADIOTRON UX-229
Full-Wave Rectifier

RADIOTRON UX-281
Full-Wave Rectifier

RADIOTRON UX-276
Voltage Regulator Tube

RADIOTRON UV-276
Ballast Tube

RADIOTRON UV-288
Ballast Tube

RADIOTRON UV-288
Ballast Tube

RADIOTRON UV-288
Ballast Tube

RADIOTRON UV-288
Ballast Tube

RADIOTRON UV-288
Ballast Tube

RADIOTRON UV-288
Ballast Tube

RADIOTRON UV-288
Ballast Tube

RADIOTRON UV-288
Ballast Tube

RADIOTRON UV-288
Ballast Tube

RADIOTRON UV-288
Ballast Tube

RADIOTRON UV-288
Ballast Tube

RADIOTRON UV-288
Ballast Tube

RADIOTRON UV-288
Ballast Tube

RADIOTRON UV-288
Ballast Tube

RADIOTRON UV-288
Ballast Tube

RADIOTRON UV-288
Ballast Tube

RADIOTRON UV-288
Ballast Tube

The standard by
which other vacuum
tubes are rated



Look for this mark
on every Radiotron



Nation-wide broadcast-
ing, for audiences of millions,
has been made possible by
the development of RCA
Radiotrons for all uses in both
transmitting and receiving
instruments. They are the
acknowledged standard in
vacuum tube design in the
radio industry.

Radiotrons are the heart of the receiving set. To main-
tain fine reception the vacuum tubes in your set should
be replaced with new Radiotrons at least once a year.
Do not use new tubes with old. Best results are
obtained by changing all tubes at one time.

RCA Radiotron

MADE BY THE MAKERS OF THE RADIOLA

RADIO CORPORATION OF AMERICA • NEW YORK • CHICAGO • SAN FRANCISCO

You May Find the One Idea You Need Here

Five Quick Motor Car Tricks

*Does the Rain Drown Your Motor? Is the Window Cracked?
Do Insects Clog Your Radiator? Here's How Others Fixed It*

GENERALLY when your motor refuses to start after a heavy rain it is because water has leaked through the hinge joining the two sections of the hood. Fig. 1 shows how a gutter of sheet iron or, preferably, brass can be constructed to carry the water harmlessly away.

Fixing Broken Window

BROKEN or cracked glass windows on an automobile are dangerous as well as unsightly. If the glass has broken in a clean crack, without shattering at any point, it can be repaired so that the crack will hardly be visible, as shown in Fig. 2.

Obtain a good grade of transparent glass or celluloid cement and a sheet of celluloid. Remove the glass and cement it at the cracks, laying the glass on a perfectly smooth surface if possible. Next, with a soft brush, paint the surface of the glass with the cement. Lay on the sheet of celluloid smoothly to avoid air bubbles. Place a smooth board on the celluloid with weights on top of it until the cement has dried.

A Radiator Screen

TO END the nuisance of insects in your radiator when the pests swarm in summer,

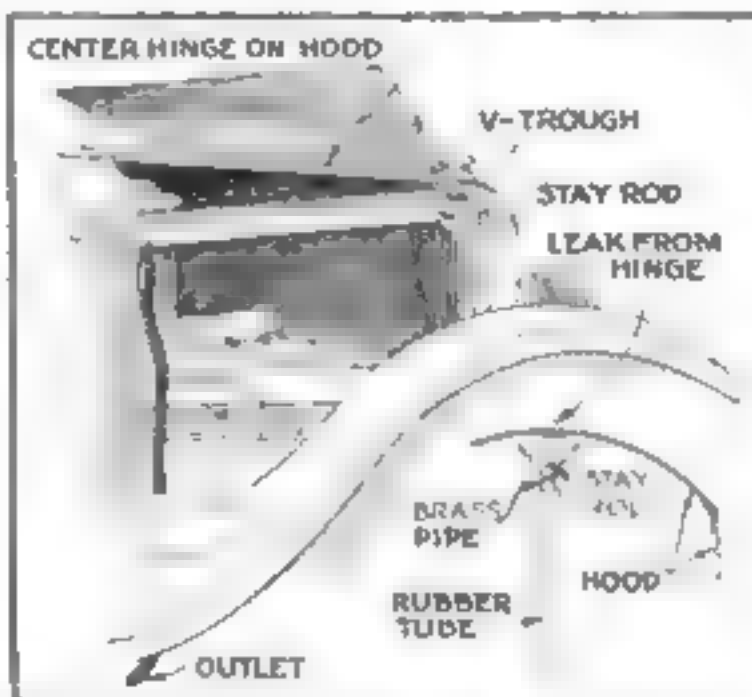


Fig. 1. This easily constructed rain gutter catches drops of water that leak through the hinge at the top of the hood, and carries them to the ground through a pipe.

keep them out with close-mesh window screening as shown in Fig. 4. After cutting to size, the screen is held in place at several points by wires threaded through the holes in the radiator.

A Quick Way to Find Cotter-Pin Holes

WHEN the bolt and nut are greasy and the light is not particularly good, it is extremely difficult to find a cotter-pin hole.

A time-saving and ingenious idea is to file an indicator mark across the end of the bolt exactly in line with the cotter-pin hole, as shown in Fig. 3. Then you can line up the slots in the castellated nut with this mark and know that the cotter-pin hole will be exactly in line.

How to Get Rid of Annoying Fumes

IF YOUR car lacks a device to carry off fumes from the crank case and prevent their entering the body of the machine, you can fit such a device as shown in Fig. 5. A half-inch pipe is brazed or soldered into the side of the oil filler pipe and the end of it brought down below the motor. The holes in the cover are plugged.

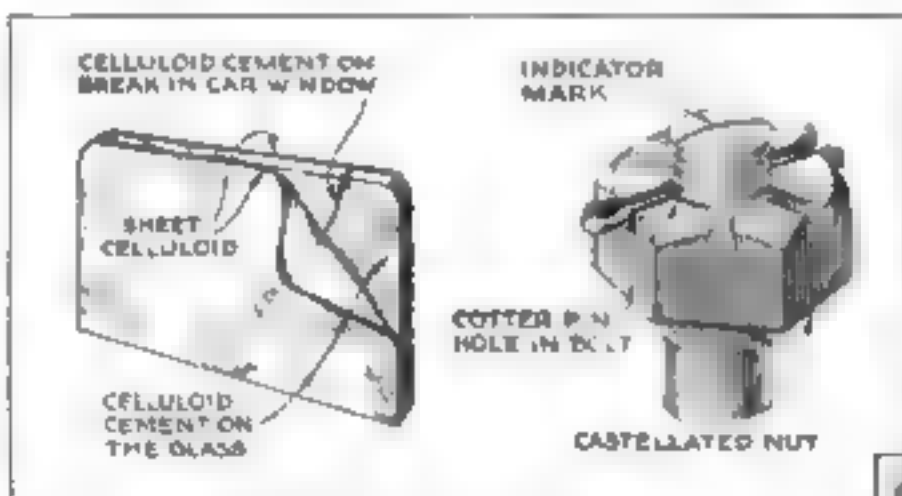


Fig. 2 (at left) shows a neat way of repairing a cracked window with sheet celluloid. Fig. 3 (at right) is a time-saving idea for locating a cotter-pin hole by a mark on the bolt.

Ten Dollars for an Idea!

THIS month's prize for the most valuable idea for motorists is awarded to Clarence Clevenger, of Santa Clara, Calif. His contribution, a time-saving kink for locating cotter-pin holes, is shown in Fig. 3 and described elsewhere on this page.

Each month Popular Science awards \$10, in addition to regular space rates, for the idea most useful to car owners. Other contributions published are paid for at our usual rates. What particular piece of originality has added to your motor car enjoyment? Write it down and send it to the Technical Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City.

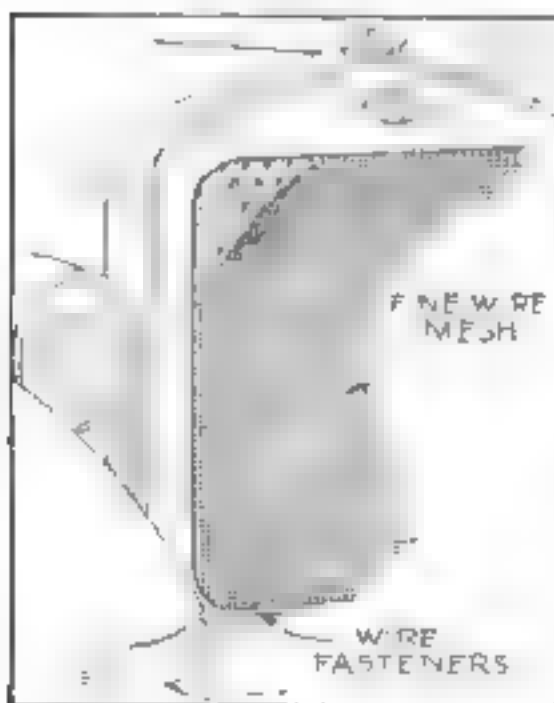


Fig. 4. A piece of close-mesh window screening, fastened to the radiator with wires, keeps insects out of the openings.

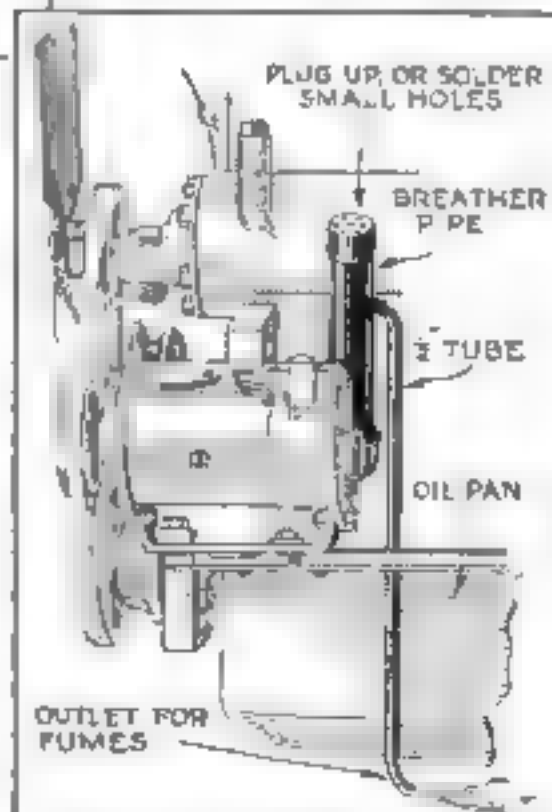


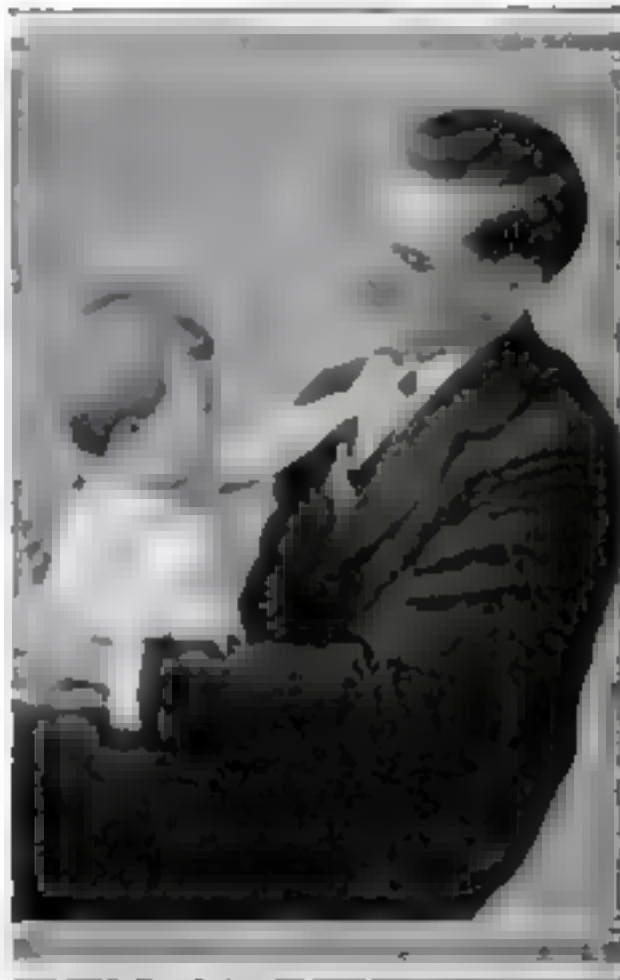
Fig. 5. A half-inch pipe, fastened into the side of the oil filler pipe and brought downward, carries off crank case fumes.



The "high spots" of my life are in those reels



Picture courtesy of La Salle Military Academy



THE thought first came to me years ago one day as I sat in a movie theater watching a news reel. A mayor threw out the first baseball of the season; a governor laid a cornerstone; a president addressed the multitude; boxers signed up for fights; runners broke records; foreign celebrities came down gangplanks.

If I were one of these much-filmed people, I said to myself, I'd arrange to get a copy of all the shots they took of me. Then I'd put them together in one reel and call it "The High Spots of My Life."

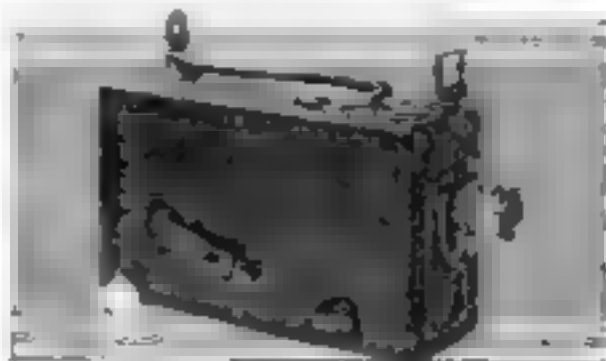
Just a week later, a real coincidence came about. For my birthday, my father presented me with one of the first Ciné-Kodaks. At once it occurred to me, that even though News Reel Feature cameras should never be aimed my way, I could now make my own film of life's high spots.

Not long afterward, Commencement Day arrived, the climax of a wonderful four years at prep school. That was indeed a high spot, and my Ciné-Kodak got every bit of it. I left college to be married, another of those events that usually occur but once in a man's life. My wedding made another thrilling reel.

"I was out on the Coast when our baby was born, and it was months before I could leave. You can imagine how impatient I was to get back home, and what that one moment was like when, for the first time, I held my baby in my arms. But, of course, that big moment doesn't have to be imagined. I can turn on my Kodascope and show it to you on the home screen. You can see me, the youngster on my knee, almost bursting with pride."

How would you like to sit in your own living room and watch events flash by that happened years ago and in which the leading part was played by you?

Thousands of Ciné-Kodak users are now having that very experience. Home movies have been made as simple as snapshots. Unbiased by the precedents and prejudices of



professional cinema camera design, the men who made still photography so easy have now made home movie making equally simple for you. The result is that the Ciné-Kodak is the simplest home movie camera.

As for Ciné-Kodak Film, it is extremely inexpensive because the cost of developing is included in the price. Projection is just as easy as photography. That, too, has been simplified by Eastman methods. It takes no more skill to operate a Kodascope than to run a phonograph, and the pictures on the screen are so distinct and lifelike that you marvel at having taken them yourself.

You will find a demonstration of home movies extremely fascinating. Stop in at your Ciné-Kodak dealer's and ask him to tell you about the Ciné-Kodak. Or send for interesting booklet.

EASTMAN KODAK COMPANY

Dept. 133, Rochester, N. Y.

Please send me, FREE and without obligation, the booklet telling me how I can easily make my own movies.

Name

Address

Giant Model Airplane

By
J. DANNER BUNCH
and AVISON F. KOCH



IF YOU wish to give your neighbor, school, or model club a thrill, build a giant airplane model like that illustrated. Only by seeing the enormous model soar away in flight can one realize the sensation it creates among the spectators. And as for the builder—he has not only the joy of flying it but also the satisfaction of having assembled a model that closely approaches a full size airplane in many particulars of its design and construction.

The fuselage is the two-stick, tapered type. The 5-ft. longerons are made of white pine, they are $\frac{3}{4}$ by $\frac{3}{4}$ in. at the greatest depth, which occurs at a point 12 in. from the nose. This is the point where the rear undercarriage struts are attached, and where the greatest strain occurs. From this point the longerons

taper forward to the nose where they are $\frac{1}{2}$ in. deep and $\frac{1}{2}$ in. wide. From this same point the longerons also taper toward the rear end at which place they are 10 in. deep and $\frac{1}{2}$ in. wide. Make an angle cut $\frac{1}{2}$ in. long at the nose so that they fit together snugly and glue and bind them together with a few wraps of silk thread.

The compression struts are made of bamboo $\frac{1}{2}$ by $\frac{1}{2}$ in. The front strut is located 9 in. from the nose and holds the longerons $2\frac{1}{2}$ in. apart; the second strut, 21 in. from the nose, holds them $2\frac{1}{2}$ in. apart; the third strut, 30 in. back, holds them $1\frac{1}{2}$ in. apart; the fourth strut, 53 in. back, holds them $\frac{1}{2}$ in. apart. The ends of the struts are shaped and wedge shape and glued and forced into slots in the longerons. These slots are made by forcing the point of a knife blade into the side grain of the wood.

Make an angle cut at the rear of the longerons 1 in. long, first true up the fuselage by sliding the longerons one way or the other, then glue and bind them with a few wraps of silk thread.

Cut a bearing block from white pine $\frac{1}{2}$ in. thick, $\frac{3}{4}$ in. high and $\frac{3}{4}$ in. long at the top and 1 in. at the bottom. Groove the top to form a cradle for the bearing. The bearing is a bicycle spoke nipple. Glue and bind the bearing assembly to the top of the nose of the fuselage.

Drill a $\frac{1}{8}$ -in. hole vertically through the fuselage 1 in. from the tail. Make a hook from a $\frac{1}{8}$ in. bicycle spoke to hold the rear end of the rubber motor; pass it through the hole and bind and glue in place. Leave $1\frac{1}{2}$ in. of the wire on the underside to form a tail skid.

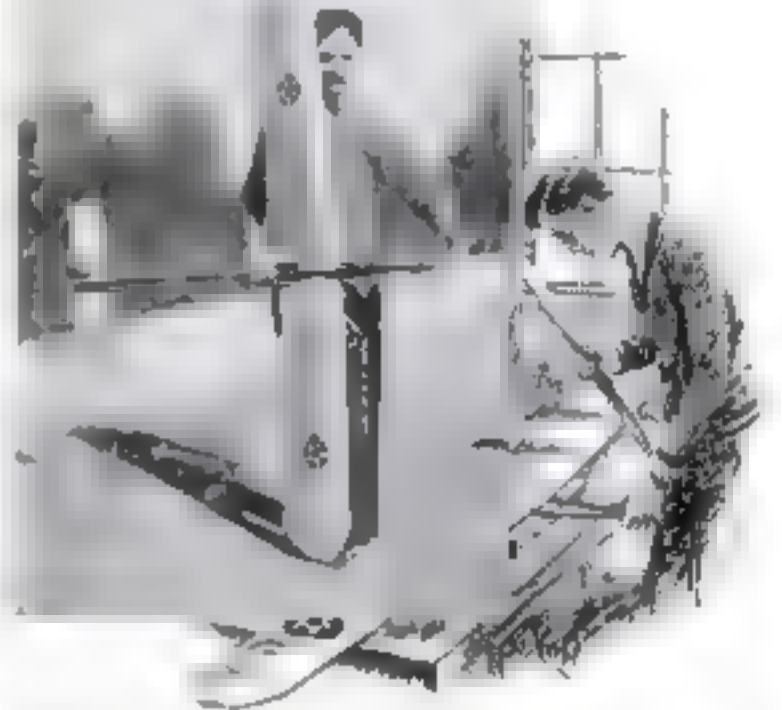
There are two rubber guides—one is 13 in. from the nose, the other is 32 in. back, and both are made of $\frac{1}{8}$ in. diameter piano wire. To make a guide, form a ring $1\frac{1}{4}$ in. in diameter and bend the wires parallel to one another for $\frac{1}{2}$ in. in the same plane as the ring. Glue and bind together here. Spread the legs until they reach the longerons and bend into an oval loop in the same plane as the longerons; bind in place with thread and glue. The wires should be just high enough for the rubber to pass through its center.

The longerons should be reinforced by binding them with silk thread at points 12 and 7 in.

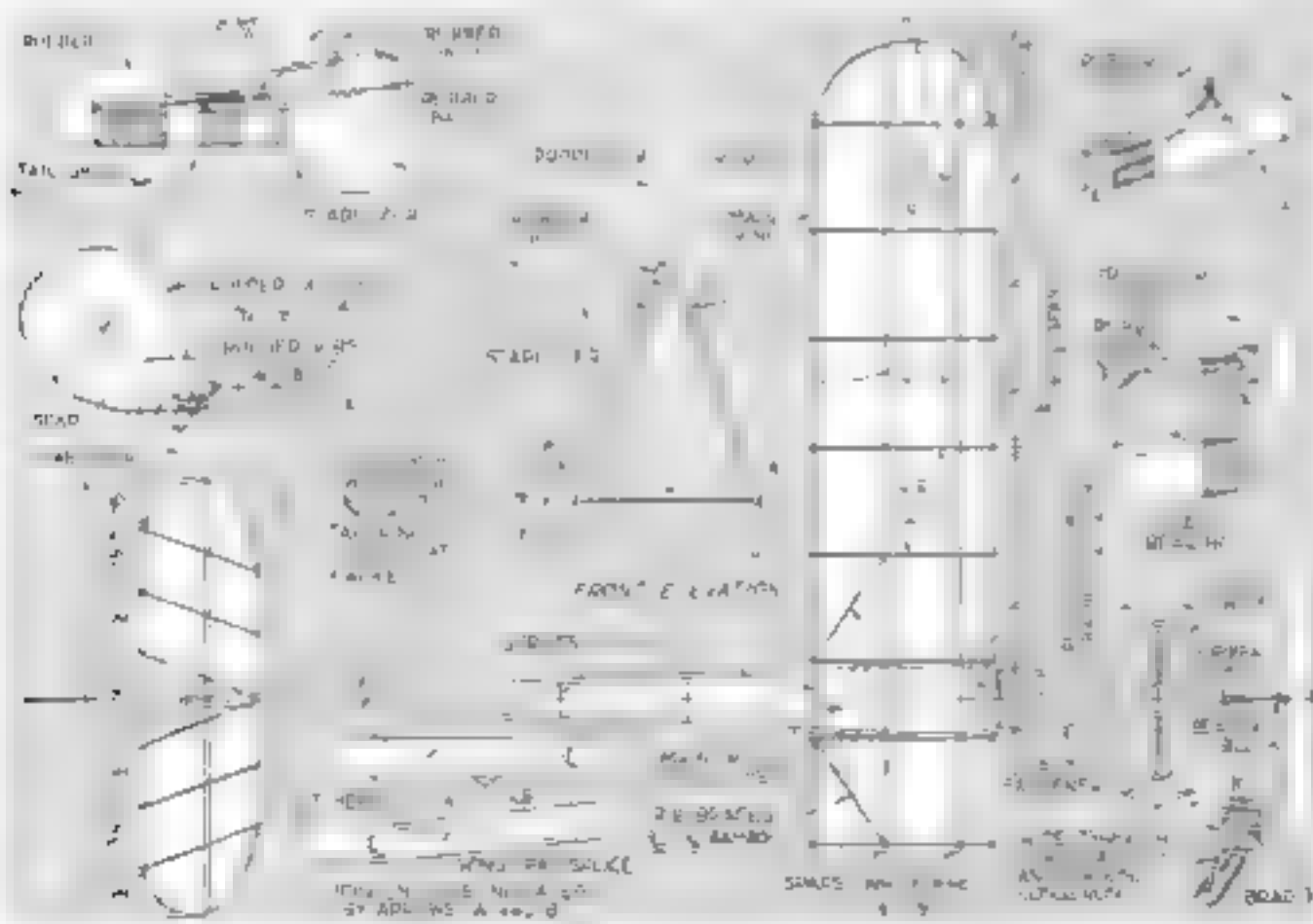
(Continued on page 100)



THE GIGANTIC AIRPLANE
BUILT BY J. DANNER BUNCH
AND AVISON F. KOCH
IS SHOWN IN FIGURE 1

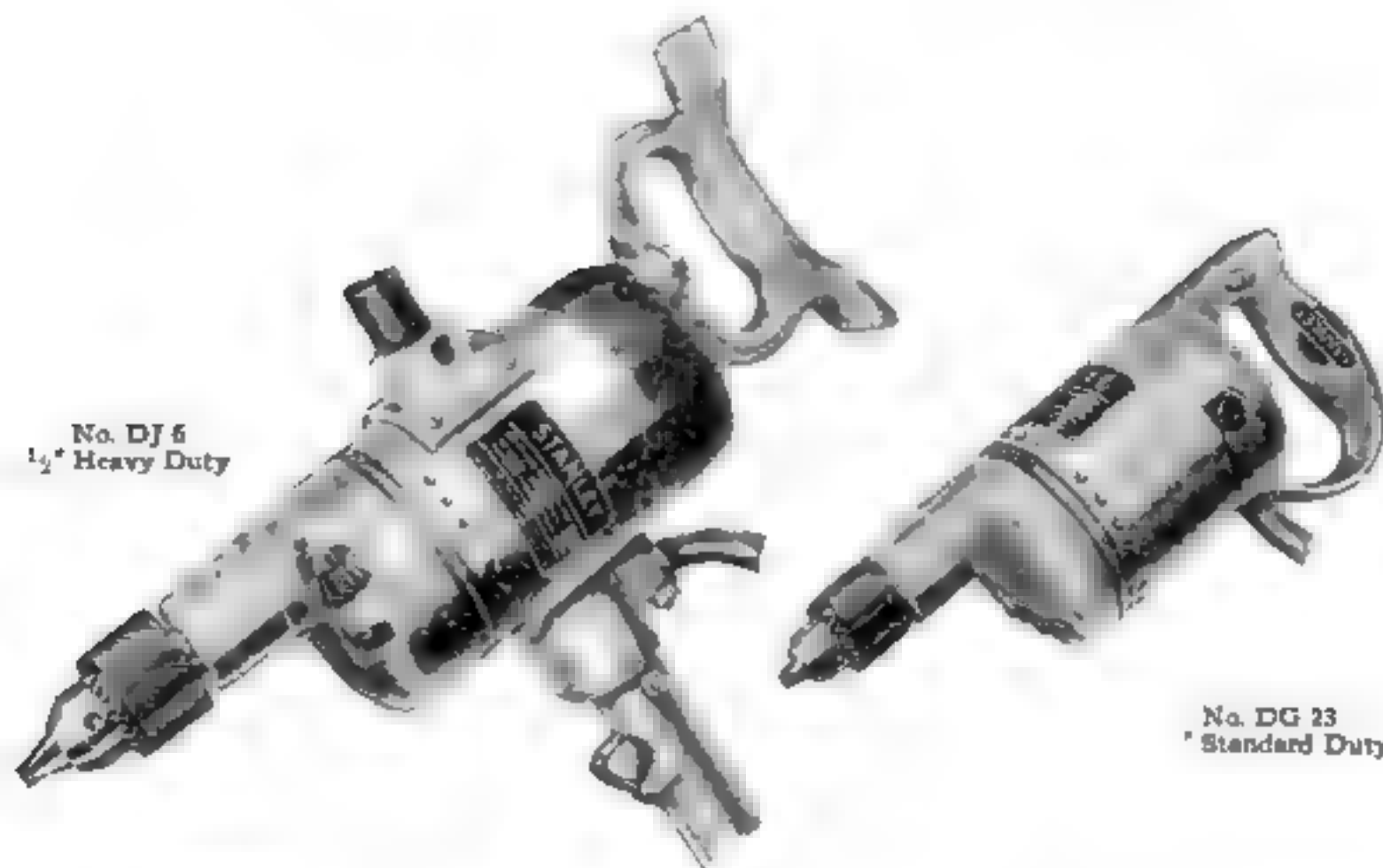


Bunch holds the model in front of him so as to give you an idea of its size. The covering of the wing is China silk.



Top and front views of the assembled model, side view of the rudder and detail of the rubber hook and tail skid, rubber guides or "ears," shaft bearing, undercarriage fastening, and splice for the two wing spars.

No. DJ 6
1½" Heavy Duty



No. DG 23
" Standard Duty

No. DB 14
½" Heavy Duty



INTRODUCING new efficiency in electric drill performance

Stanley Electric Drills will operate continuously at full rated capacity with only an 8° rise in temperature. A new and unique design in ventilating systems makes this feat possible.

Stanley Electric Drills are also equipped with exceptionally powerful motors that give adequate reserve power. Simple, compact design eliminates projecting parts and makes the drills both strong and rigid. The handle fits the hand and the switch is so placed that it can be operated without releasing the firm grip necessary to hold a drill against the work.

The new Stanley Electric Drills can be inspected at your dealer's. Try them on steel; on iron; on hard wood. You will thus prove

to yourself, point by point, that they do the hardest work with the least strain or effort.

Send coupon for catalog No. Se59 which describes the full line of Stanley Electric Drills, Grinders and attachments.



The Stanley Works, New Britain, Conn.

Please send me Booklet Se59, describing Stanley Electric Drills.

Name _____

City _____ State _____



STANLEY TOOLS

The choice of most carpenters

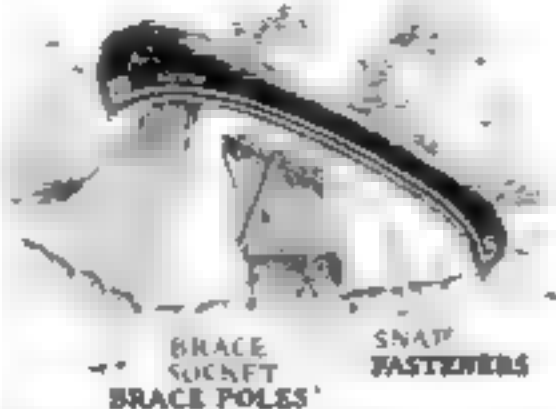
Ingenious Kinks for Campers

Twelve Ways to Make Outdoor Life More Enjoyable



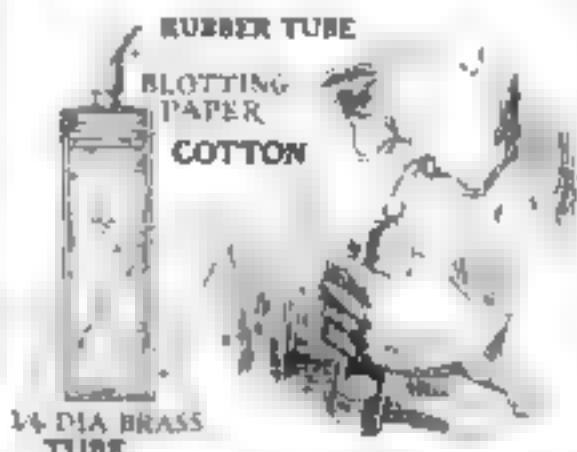
CANDLE
TIN CAN

If your flashlight fails, a candle and a can will make a lantern, but watch out for fire.



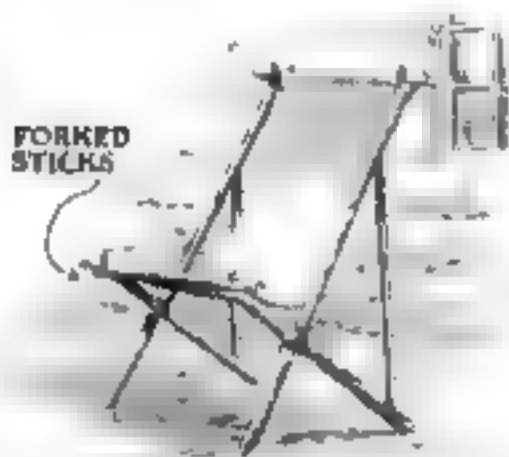
BRACE
POLE
SNAP
FASTENERS

Prope and special curtains convert a canoe into a waterproof shelter in times of storm.



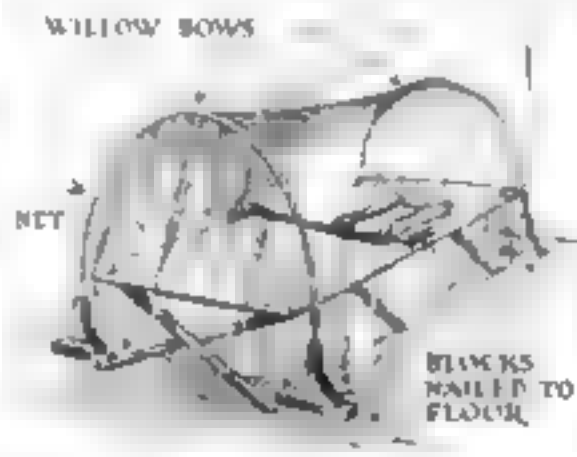
RUBBER TUBE
BLOTTING
PAPER
COTTON
1/4 DIA BRASS
TUBE

When the surface water is contaminated, this filter gives the camper a cleaner, safer drink.



FORKED
STICKS

This chair is an old standby; you can make it quickly if you have the necessary canvas.



WILLOW BOWS

NET

BLOCKS
NAILED TO
FLOOR

When mosquitoes infect the camp, netting over each cot insures a good night's sleep.



CANVAS BAG

INNER TUBE
VALVE STEM
(coiled)

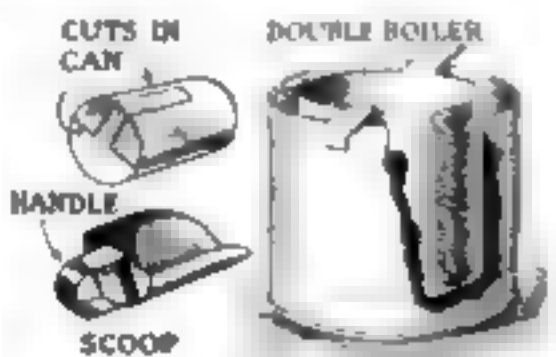
Air cushions made from old inner tubes will add comfort in camp, canoe, and motor boat.



REINFORCED
STAKE

DOUBLE STAKES (for sandy soil)

Two simple ways to make tent stakes hold fast in sandy soil and blustery weather.

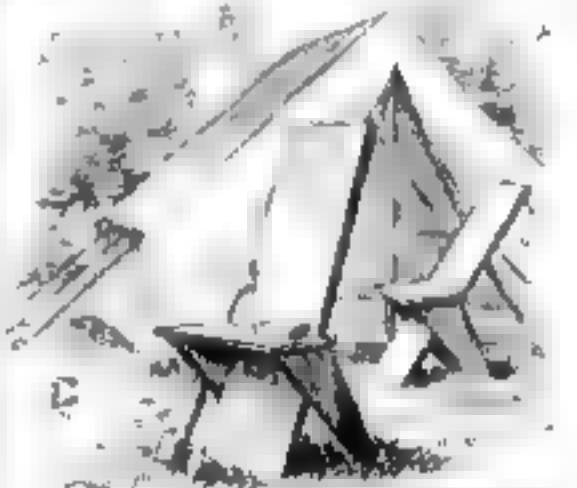


CUTS IN
CAN

DOUBLE BOILER

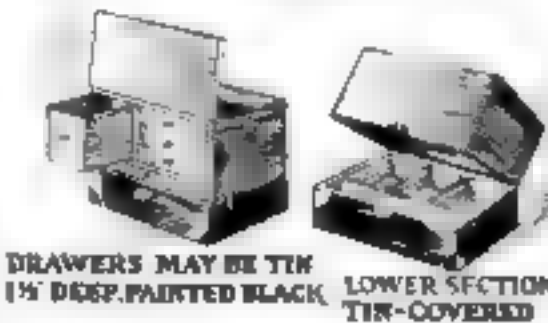
HANDLE
SCOOP

From the cans in which so much camp food comes, you can form many cooking utensils.



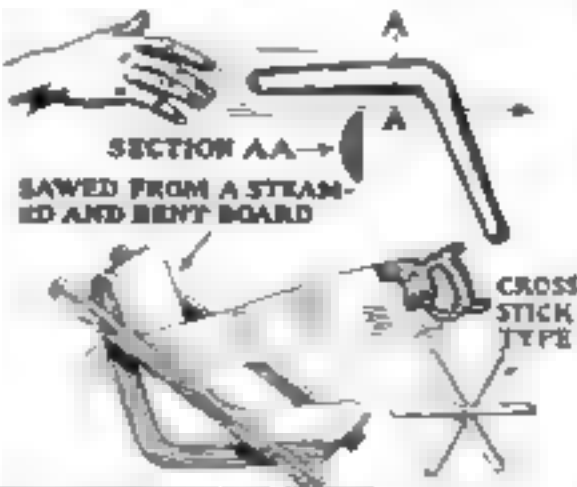
Hammer and saw, a board, a few nails—and you can make this type of chair in no time.

BOX CLOSED IS 8" x 8 1/2" x 13"



DRAWERS MAY BE TIN
1 1/2" DEEP, PAINTED BLACK
LOWER SECTION
TIN-COVERED

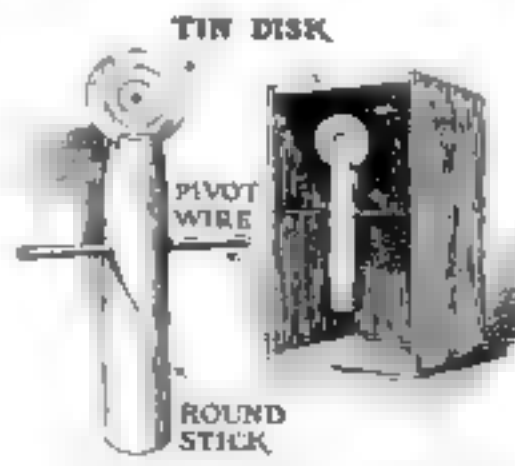
Oak 1/4 in. thick and tin are the materials used in making this roomy fishing-tackle box.



SECTION AA
SAWED FROM A STEAM-
ED AND BENT BOARD

CROSS
STICK
TYPE

There is more interest than ever in throwing the tricky boomerang. Here are two types.



TIN DISK

PIVOT
WIRE

ROUND
STICK

This target is for the boy who takes his air rifle to camp. The disk bobs whenever hit.

On the job, when you want it . . . all the time

WHEN you're in a hurry; when you're working in a high wind; when it's bitter cold; when you've got an indoor job—any time you need a fire-pot you'll be better off if it's a Clayton & Lambert.

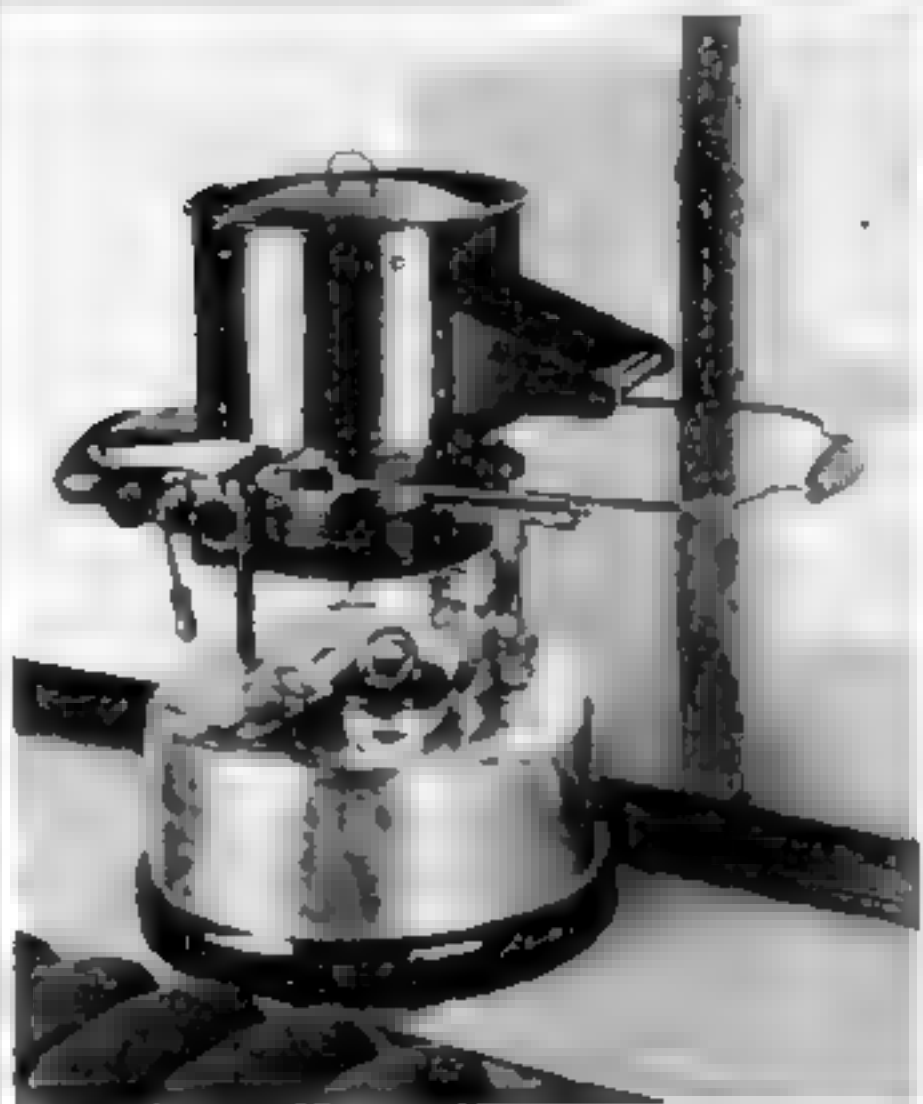
You can light it and have it heating things up for you in ninety seconds! Your generator is shielded from wind! And it's so fast-acting that cold weather can't slow it up. And if you're using either Clayton & Lambert No. 70 or No. 60 you've got such a quiet fire-pot you can't disturb anybody. Of course No. 22, the coil fire-pot, makes a bit of noise—but you can't expect such a tremendously powerful blast as that to whisper!

And here's something. They're built like a battleship, as far as strength goes. Everything rugged. Made for hard, rough work. Just take a look at that bright red, protecting ring around the base of the tank, if you want to see how we make



CLAYTON
&
LAMBERT
MANUFACTURING CO.
DETROIT, MICHIGAN

This is the Clayton & Lambert No. 70 fire-pot with timer's hood. Produces a working flame in ninety seconds. Flame controlled as easily as a lamp. The burner orifice cannot be enlarged by tightening the needle valve. No chance of ruining the fire-pot that way—that's an exclusive C & L feature. Will heat a pair of soldering coppers and melt a pot of metal at the same time.



Clayton & Lambert fire-pots give you long service, free from trouble.

But in spite of all that extra strength and protection, they're lighter than fire-pots have been. You won't get round shouldered carrying these around.

Just remember that name Clayton & Lambert next time you're buying a fire-pot. If you've got a fire-pot now that gives you exceptionally good service, take a look and see if you don't find the Clayton & Lambert name on it! And we can promise you better performance in the new models. See them at your regular supply house.



This is the Clayton & Lambert No. 22 fire-pot. It is deservedly popular because of its easily understood design and its powerful blast. Recent improvements and Clayton & Lambert patented features make this model particularly desirable. The burner jet is easily removed to permit cleaning and flushing of the coils. The coil cups on both bottom and sides are made in three pieces and may be quickly detached. Sturdy construction and popular price make this tool a favorite with the plumbing trade.

Sharpening Milling Cutters

Small Shop Methods for Grinding Plain and Spiral Mills — A Universal Tooth-Rest — Clearance Angles

By HECTOR J. CHAMBERLAND



Grinding on a
new and
the old

IN SHARPENING plain or spiral milling cutters, side mills, and mills, angular cutters, counterbores and reamers, the toolmaker or machinist has to observe two essential requirements. First, he must know the proper clearance angle, and secondly, he has to provide a good rest for the teeth.

On the clearance angle depend largely the success of a milling job and the life of the cutter. I am inclined to think that it is as important as the steel from which the cutter is made, the material to be cut, or the speed, feed, and other factors. Too much clearance will weaken the cutting edges and make necessary too frequent grindings; not enough clearance will strain the spindle and arbor, reduce production, and result in a poor finish on the work.

Many cutters used today are of the coarse feed type with an average undercut or rake of about 10° . Guesswork should be eliminated in grinding the teeth. Small gages such as those shown in the diagram marked Fig. 1 on page 116 can be made quickly and will help to insure good results. A complete set of 5° , 8° , 10° , 12° , and 15° gages should be kept on hand.

The average clearance recommended for steel is 5° ; this may vary about 1° either way depending upon the steel being cut. For bronze the clearance should be 8° or 9° ; for aluminum from 10° to 12° , and for cast iron 6° or 7° . It follows that if a cutter has a 5° clearance angle and a 10° undercut, the protractor reading should be 15° . This obvious fact is too often overlooked with bad results.

A substantial tooth-rest is essential. One such as that illustrated in Fig. 2 has few, if any, superiors. It has a clapper-box mounting and is universal in range. The finger itself is of heavy gage stock reinforced by means of the 90° twist. The spring which acts upon the pivoted finger holder makes indexing very reliable, even when heavy cutters are being ground.



Both disk and cup wheels are used for sharpening milling cutters. If it is possible to use it, the disk wheel is to be recommended. On plain mills, where the teeth are close

together, it is often necessary to use a cup wheel so as to avoid grinding off the edge of the tooth above. Also, in the case of cutters with coarse teeth, where the land has attained a width of $\frac{1}{4}$ in., the cup wheel should be used, for the reason that the curvature resulting from the disk wheel weakens the cutting edge. The cup wheel is also valuable for renewing the secondary clearance of mills of this type, thereby retaining the land at the desired width, as in Fig. 3.

For grinding spiral mills, the tooth-rest is, of course, bolted to the wheel head and the finger relieved in the center, as in Fig. 4. The finger should be wide enough to project $\frac{1}{4}$ in. at each side of the wheel.

A FINGER to be used for sharpening alternate teeth milling cutters is illustrated in Fig. 5. Its shape allows both angles to be ground at the same setting. The cutting edge of the wheel should not be more than $\frac{1}{4}$ in. wide, and while grinding the teeth it should not pass beyond the center of the finger.

The top teeth of side mills are ground with a disk wheel. The tooth-rest may be used on the wheel head or on the table, as in Fig. 6. A cup wheel is used for the side teeth. The set-up is the same as for the end teeth on end mills, only a stud is used instead of a cylindrical bar. A clearance angle of $2\frac{1}{2}^\circ$ is desirable for the work, although in some cases a clearance of from 2° to 3° is recommended. The grinding should be either square with the top or concaved from .005 to .001 in.

End mills require special attention. When new these tools are ground cylindri-

cally on the body to within .005 in. of their finished size. They are then cleared, this operation being done to eliminate the burr and save the temper. In resharpening end mills the same results may be obtained by following the method shown in Fig. 7. Note the running direction of the wheel and the position of the tooth-rest. The operator must be careful to hold the tool steady against the finger. A dog is clamped on the shank of the mill to make the operation more convenient.

The set-up in Fig. 8 is for a left-hand mill with a left-hand spiral, in Fig. 9, for a right-hand cut with a right-hand spiral. Right-hand teeth are done on the front edge of the wheel, left-hand on the rear edge.

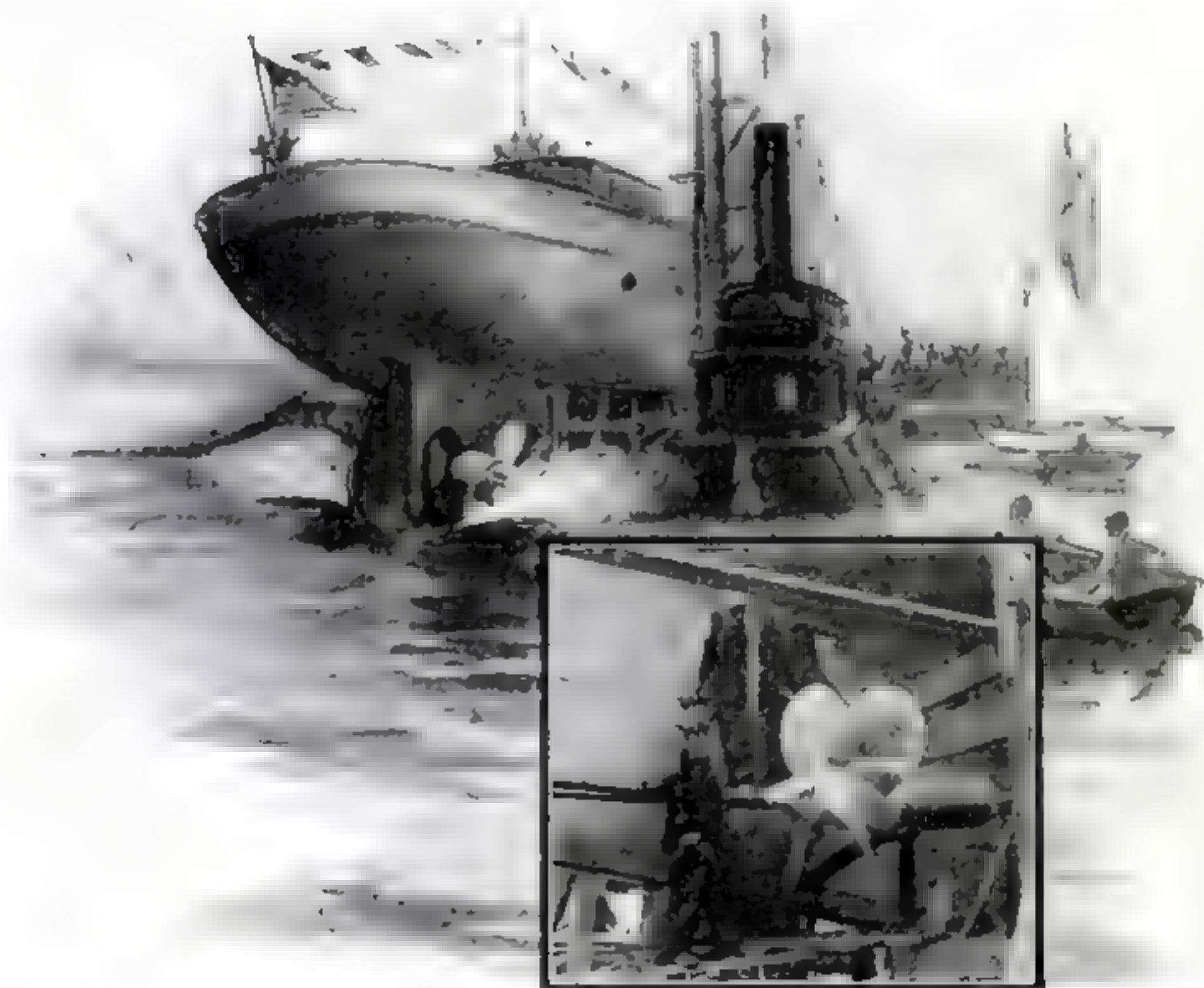
For grinding end mills with a threaded center hole in the shank end, a centered screw should be used, as in Fig. 10.

In sharpening counterbores, the important factor is to have the teeth square or slightly convex, as a slight concavity on the work will do no harm. As shown in Fig. 11, a cup wheel is recommended as it makes it easier to obtain a square corner near the pilot.

GRINDING the teeth on angular cutters presents an opportunity for argument. An angular cutter may be considered as a number of plain milling cutters of different diameters ganged together, for which reason some mechanics give the preference to the disk wheel. The fact is that when any cutter is ground with a cup wheel and the regular vertical attachment is used, the clearance angle is determined by the diameter of the cutter; whereas, when the disk wheel is used and the same method followed to obtain the clearance, it is not the cutter but the grinding wheel which is the varying factor. In deciding which wheel to use, both the thickness of *(Continued on page 116)*



A spiral milling cutter set up for grinding on one of the familiar standard types of universal tool and cutter grinding machines.



Down to the sea with Starrett's

From the ways at Lawley's yard slides the largest Diesel powered yacht ever built. Up through Belle Isle races forty feet of spray hidden Mahogany. Off Montauk an express cruiser maintains her steady twelve knots.

Every shipyard is equipped with Starrett Tools. Marine machinists and carpenters have come to rely upon Starrett accuracy that the development of marine transportation may keep pace with that of land and air.

In industry or in the home shop, wherever accuracy and good workmanship count, you'll find Starrett Tools the favorites. Write for free copy of Starrett Catalog No. 24 "W"

THE L. S. STARRETT CO.

World's Greatest Toolmakers
Manufacturers of Hackaws Unscruffed
Steel Tapes—Standard for Accuracy
ATHOL, MASS., U.S.A.



Use Starrett Tools

Two Aids in Using Your Lathe

Radius Attachment for Large Work

AN INEXPENSIVE way of rigging up a lathe for turning a large radius is shown in the illustration below. While of a temporary nature, it is free from the troubles which usually accompany makeshifts and enables the work to be turned out rapidly and accurately. For the same reason, the arrangement is well adapted for handling a number of duplicate pieces. Once made, it can be quickly set up at any future time. A few machine bolts, a bar of heavy flat stock, and some scrap pieces of steel are all that are required by way of materials.

The swing of the radius is obtained by the cold-rolled flat bar *A*. This carries a regular lathe bit *B* at the front end and is pivoted at *C*, while it can make a radial sliding movement along the fulcrum *D* on the compound rest.

The manner of holding the cutter and of controlling the radial movement of the bar is shown in Fig. 2 of the same illustration. The regular tool post is replaced by a heavy screw *E*. The head of *E* is seated in a square washer *F*, which fits the T-slot in the compound rest. Screw *E* is solidly clamped in place by a nut *G* seated in a cup-shaped piece *H*, there being enough space in the cup to allow a hexagon socket wrench to enter it. A washer *I*, which rests on top of *H*, supports the bar *A* and determines the elevation of the cutter, and a similar washer *J* on top of the bar is capable of fine adjustment up or down by means of a nut *K* and a locknut *L*.

Bar *A* is formed with a radial slot *M*, which permits a snug sliding movement to a collar *N* placed over the stud and resting on the lower washer *I*. Running into this



Old Bill Says—

❶ If you work to close limits, once a week you should have your micrometer tested at every one-tenth reading.

❷ Don't always blame the milling cutter—or even yourself—if it runs out; half of the time the trouble is in a sprung arbor.

❸ Worn screw slotters, ground cylindrically and to the required angle, make very good slitting disks.

❹ In cylindrical grinding, although the spindle and bearings of the machine may be in first-class condition, the wheel, as is well known to toolmakers, is thrown slightly out of true when stopped even for a few seconds. Therefore it should be dressed off each time before any grinding is done.

❺ If you have served your time in Smith's and think you know the game, just go over and work in Brown's shop, and learn as much again.

Tailstock Center for Grinding

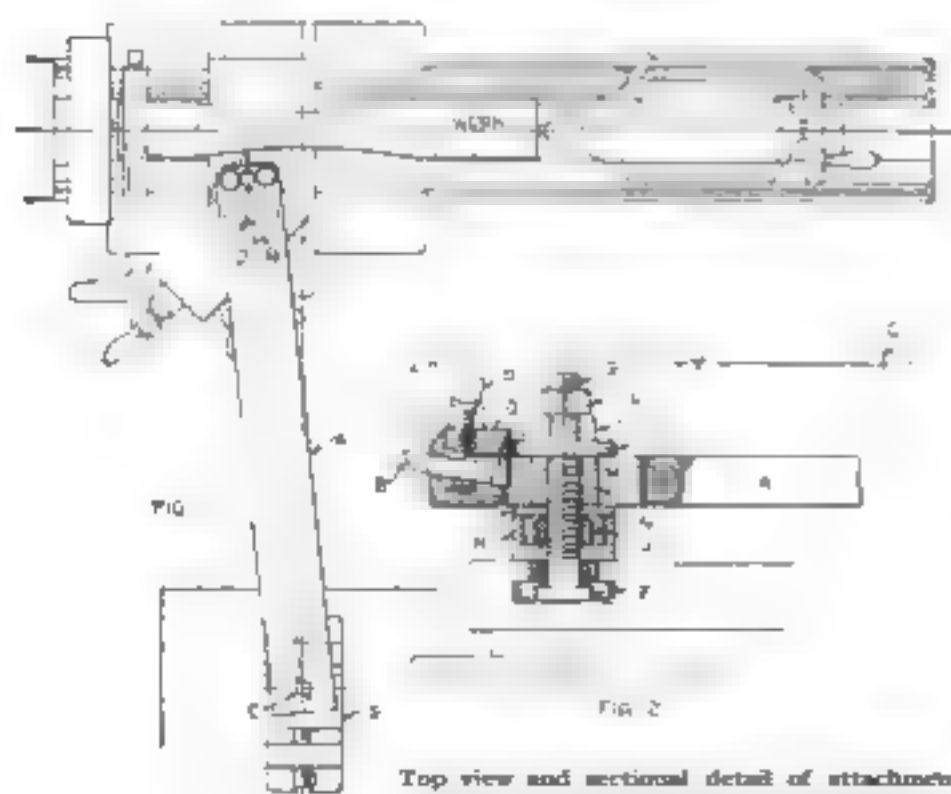
slot *M* is an inclined slot *O* for accommodating the lathe bit *B*, which is clamped in the regular way by a set screw *P* located in a crosspiece *Q* screwed to the front end of bar *A*.

The pivot or radius-center *C* is in the form of a pin fitting a hole in bar *A* and located in the top of the movable jaw of a milling machine vise *S*. This is firmly fastened down to any convenient suitable support, such as a heavy and rigid workbench, or a shop truck with the casters removed and well braced and weighted.

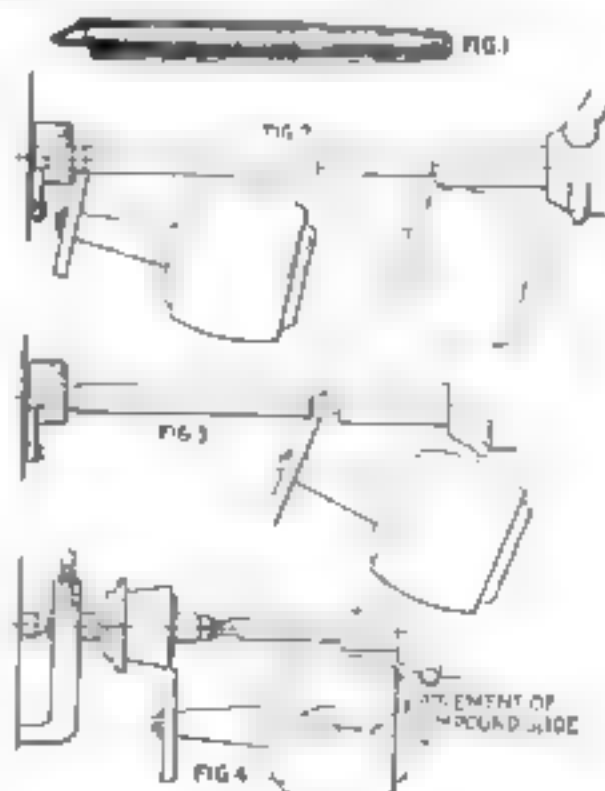
WITH the arrangement so made, turning the radius is an easy matter. Of the two distances which make up the radius, distance *Y* remains constant, and the short distance *Z* is easily obtained by slight shifts in the position of the tool, so that a very accurate adjustment of the radius is not only possible, but is easily maintained and reestablished whenever it becomes necessary to grind the bit. The screw adjustment of the vise allows the tool to be fed in as positively as if it were done with the regular feed screw.

Radii of extraordinary length can be turned in this manner without difficulty. Where the length of the bar is considerable and it has a tendency to sag, a light timber, "crown" side up, may be clamped on top of the bar over the greater part of its length.

Another valuable lathe accessory is shown in Fig. 1 of the right-hand illustration below. It is a long tailstock center. While it costs little to make, it will be found useful in any shop where grinding has to be done on. (Continued on page 117.)



Top view and sectional detail of attachment recommended by Henry Simon for turning radii.



The special center, and how and why it is used.



Brown & Sharpe Combination Set No. 438, illustrated above, has tempered blade and reversible protractor head. The level is accurately set. A high class tool for the work intended.

The Traditional Choice for Careful Work

Many a skilled worker today has been "brought up" so to speak, on Brown & Sharpe Tools. Among the mechanically expert, it has become traditional to link the name of Brown & Sharpe with fine workmanship and unfailing accuracy.

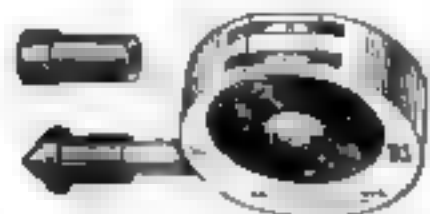
The tradition persists because the quality persists. Brown & Sharpe Tools continue to satisfy the most exacting demands of the mechanic — to do the hardest work in the most accurate and practical way.

Get Catalog No. 30 listing 2300 Brown & Sharpe Tools and over 5,000 items at your hardware dealer's; or write direct to us for it. Dept. P. S., Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.

BROWN & SHARPE Tools



* MICROMETER CALIPER
No. 11 R5



* VEST POCKET SPEED INDICATOR
No. 744



* DIAL TEST INDICATOR
No. 888



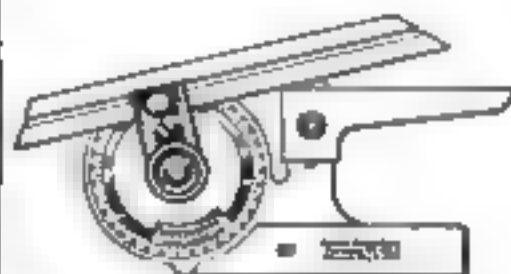
* TWIST DRILL AND STEEL
WIRE GAUGE
No. 705



* BALL END DRILL BIT
No. 615



* AUTOMATIC CENTER PUNCH
No. 771



* UNIVERSAL
BEVEL PROTRACTOR
No. 494

*A description of this tool
appears in Catalog No. 30



"WORLD'S STANDARD OF ACCURACY"



GENUINE WILLIAMS' "VULCAN" The Original Chain Pipe Vise

ECONOMIES in manufacture, due to greatly increased production; have made possible a reduction of 20% in the price of "Vulcan" Chain Pipe Vises. Genuine "Vulcan" now sell as low, or lower than less desirable and inferior imitations.

"Vulcans" are made entirely of wrought steel—no castings are tolerated. Drop-forged jaws are saw tempered for file sharpening. Unbreakable, light, compact, rapid in action, positive in grip. Will outwear any ordinary vise made.

Sold by the best dealers.

No.	For Pipe Size	Weight lbs.	Price Net f.o.b. Buffalo
1	1/8 to 2	4	\$2.52 each
2	1/4 to 4	10	3.40 "
3	1/2 to 6	18	9.72 "
4	1 to 8	30	12.96 "

Fully Guaranteed.

J. H. WILLIAMS & CO.,
"The Drop-Forging People"
246 Vulcan St., Buffalo, N.Y.

**GENUINE
WILLIAMS
"VULCAN"
DROP-FORGED
CHAIN PIPE VISE**

Tables for the Wood Turner

Two Designs to Help You in Mastering Lathe Work

By HERMAN HJORTH



Fig. 1. When tilted down, the top of this table is supported by a graceful pivoted wing.

IN NO other way can you turn your wood turning to better advantage than in making legs for decorative tables. Rarely has a home too many small tables, there is always room for a graceful occasional table like that illustrated in Fig. 1 or a book-trough end table such as is shown in Fig. 3.

The occasional table with its folding top may be used, as its name implies, for different purposes and in a room with almost any type of furniture. When folded it takes up the minimum space but still remains an ornament. Because of its adaptability it is particularly suited to modern requirements.

Three turned parts are required—two uprights exactly alike, which are glued into the feet, and one stretcher connecting them (Fig. 2). The uprights have two square parts and the stretcher three. As to the method of turning, refer to the directions given in the previous article on making a footstool (August issue, page 94). After those portions which are to be turned are finished and the cuts at the square parts have been made, round the corners slightly with a skew chisel held flat on the T-rest. Lay off the distance of the rounding—about $\frac{3}{8}$ in.—by squaring lines on all sides of the square pieces. Proceed cautiously with the cutting as shown in one of the views of Fig. 4.

A plain square rail, the same length as the stretcher, is used between the legs at the top. The joints may be made with either dowels or mortises and tenons. To this upper rail the top is hinged. Between the rail and the stretcher is pivoted the winglike table top support. Notches are cut on opposite sides of the rail to receive the projections at the upper part of the wing when it is turned parallel to the rail. The wing support is cut from $\frac{1}{4}$ - or $\frac{3}{4}$ -in. plywood and a $\frac{1}{4}$ -in. dowel is glued into each end to enter corresponding holes in the centers of the top rail and the stretcher. If desired, an additional turned rod may be inserted in the wing as suggested in Fig. 1. Obviously the wing must be put in place before the table is glued together. *(Continued on page 100.)*

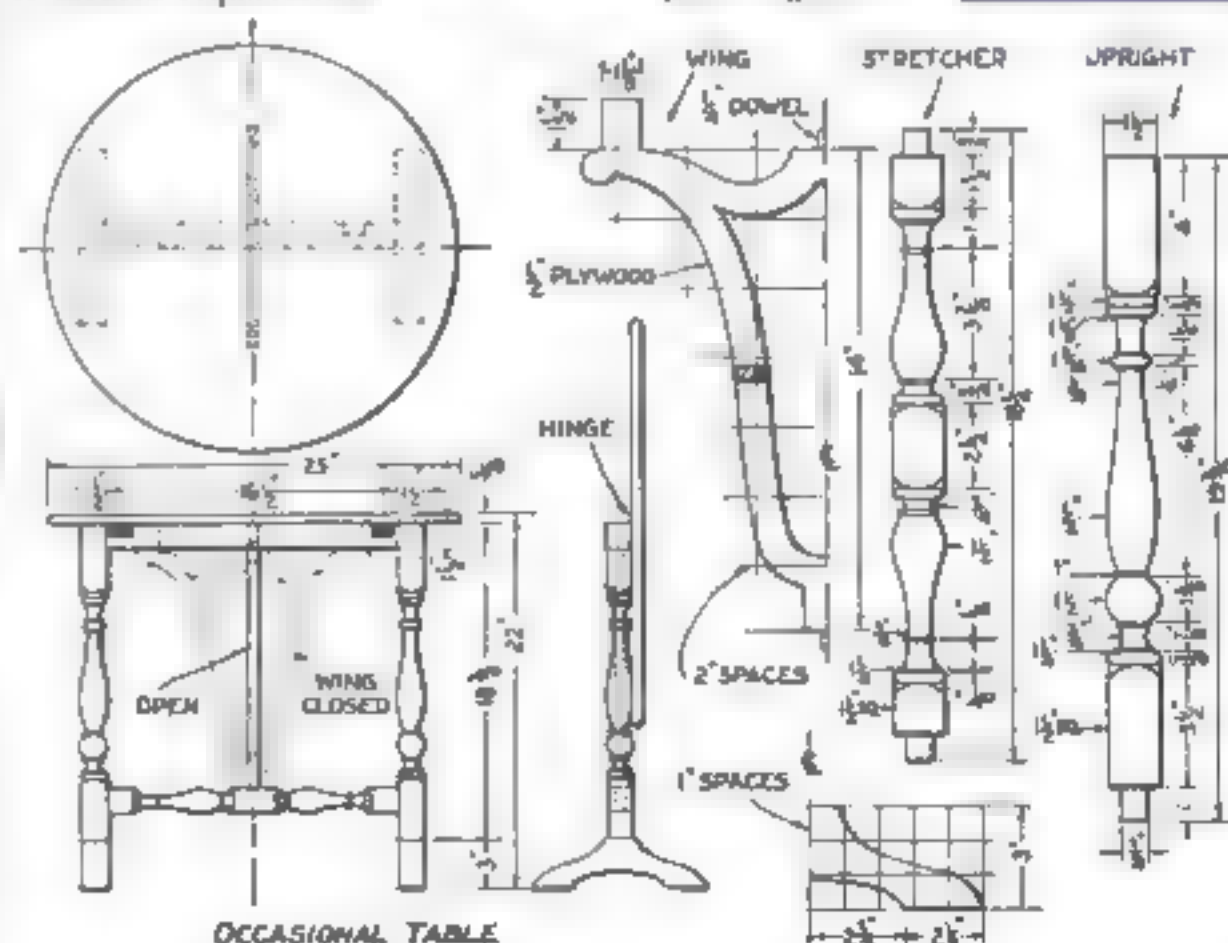


Fig. 2. Front, top, and end views of the table, and details of the uprights, feet, stretcher, and wing.

new LIGHT WEIGHT! 1/2 in. Electric Drill!



A Challenge!

Every MILLERS FALLS drill offers the finest value 60 years of fine tool making can give.

We challenge direct comparison with any other drill made. Buy on performance. Our dealer will arrange a test.

Less Weight — More Power

POWER — that's what a good drill gives. Power does the work. This new MILLERS FALLS has more power. Full 1/2 inch in steel capacity. No overheating. Long life. Stamina to stand hard use.

WEIGHT — that's what makes a drill harder to use. This new MILLERS FALLS is stripped for action. No unnecessary weight. Nothing but strength where needed.

**only
\$54.⁰⁰**

So you'll find it easy to use this drill. You'll like its speed and power. You'll like the light way it handles. Now you'll do every job that comes along with less strain. And all for only \$54.00. Never before such amazing drill value. Try it out. See your dealer for demonstration or write direct.

© M. F. C.
1928

MILLERS FALLS COMPANY

NEW YORK: 28 Warren St.
CHICAGO: 9 So. Clinton St.

MILLERS FALLS
MASSACHUSETTS

MILLERS FALLS COMPANY, Millers Falls, Mass.
Please send your electric drill order for our reference file.
Name _____ Address _____
P. 9
9-23



*A Sign
Mechanics
Believe In—*

The preference given STAR BLADES by the modern mechanic is more than ample proof of their superiority and ability to cut faster, better, with less breakage.

The Star on a Hack Saw Blade is your assurance of a better blade . . . a blade that all skilled workers rely upon.



Let us send you free samples

Clemson Brothers, Inc.
Middletown, N. Y.

MAKERS SINCE 1883

STAR HACK SAWS

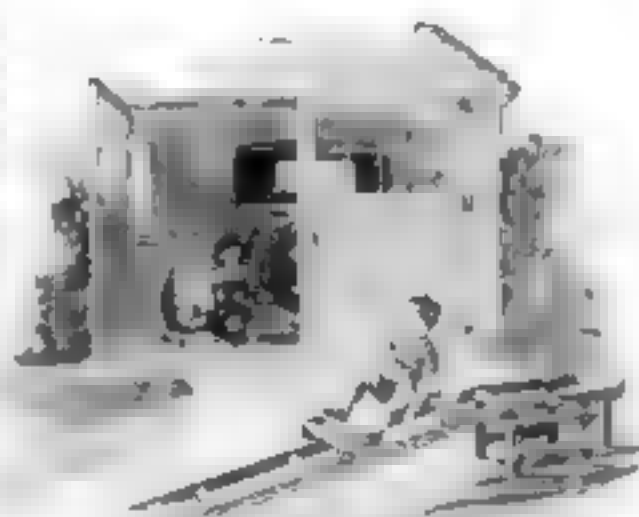


Back Yard Chute-the-Chutes

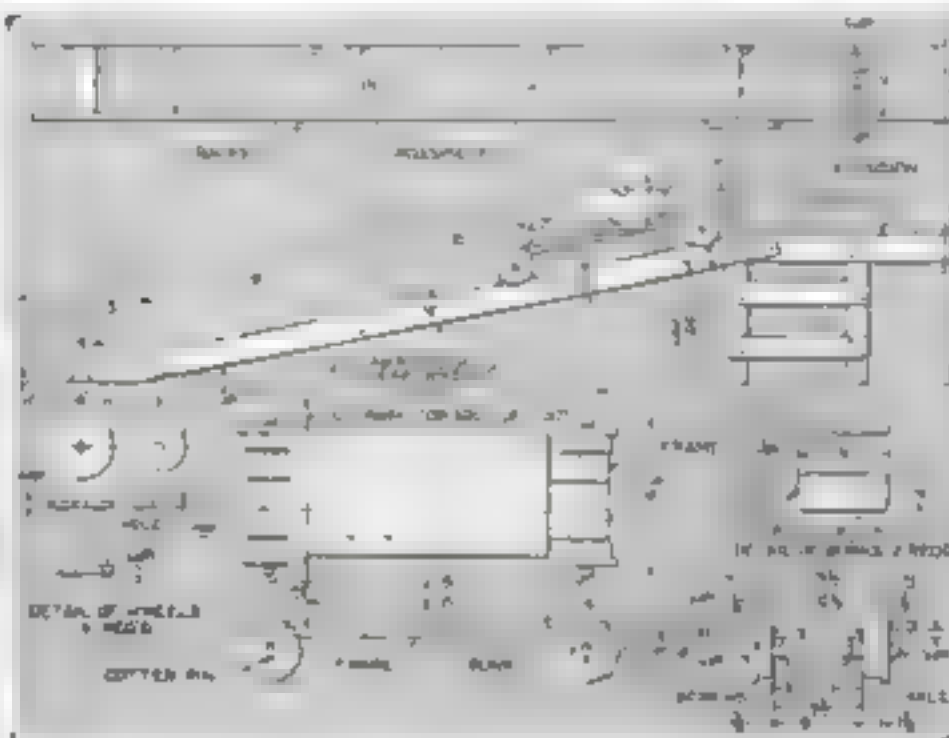
WITH odds and ends of boards, a few tools, and a moderate degree of that desirable trait "gumption," any boy can build toy "chutes" which will give him and the "gang" hours upon hours of pleasure.

Nail the tracks to the crosspieces, place the resulting ladderlike frame upon a box or a built-up support, and cut the bottom of the rails to fit the walk. Also build the 30 in. long extension upon which the car is placed at the beginning of the run.

Make the floor of the car as shown and cut and attach the "bunks" to which the broomstick axles are fastened with round-head screws. To make the wheels, cut out with a compass or fret saw four disks of $\frac{1}{4}$ -in. wood 8 in. in diameter and



Boys can have their own Cooney Island at home by building these simple inclined railways.



Plan view and side elevation of the chute and car with details of the two-piece wooden wheels and the axle supports.

four of $1\frac{1}{4}$ -in. wood 8 in. in diameter. Nail them together in pairs and bore a 1-in. hole through them to fit the axle. Apply paraffin, wax, or hard soap on the axle, put the wheels in place, add washers if large enough washers can be obtained easily, and then use cotter pins or drive in plain pins to hold the wheels in place.

In some localities it will be possible to move this amusement device to the edge of the "ol' swimmin' hole."—CHARLES A. KIND.

Making a Spanish-Colonial Wood Box



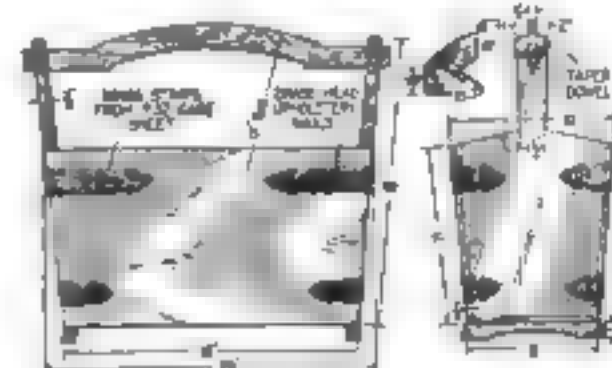
A handy carrier for logs for the fireplace.

THIS simply made Spanish-Colonial wood box for the fireplace has the advantage of being a carrier as well as a receptacle. It saves bringing dusty logs from the basement in one's arms.

The wood for the box should be chosen for its decorative grain. The original was made from selected pieces of old packing boxes and given a coat of walnut stain on the outside. The inside was painted a rich green which, with the brass ornaments, sets off the dark finish attractively.

The corners of the handle were rounded to give a comfortable grip, but elsewhere the angles were left sharp to carry out the Spanish motif. The brass corner strips

were cut out with a pair of old shears from 32-gage brass sheet, obtainable at almost any large hardware store. Note that the two halves of each strip join at an angle, so that they will lie horizontally when bent over the corners and fastened with small brass-headed upholstery tacks.—H. S.



The construction and dimensions of the wood box; how it looks in use beside the fireplace.

BLUE PRINTS

Woodworking and Other Projects

Price 25 cents each, POSTPAID

PRINTED below is a list of interesting and unusual projects that can easily be made at home with simple tools, for each of which a Blue Print has been prepared by the Editor of the Home Workshop Department of Popular Science Monthly. Each Blue Print gives complete working drawings of the project with the essential details full size wherever possible, and, in addition, a complete bill of materials. Use the coupon for ordering Popular Science Blue Prints.

No.	Title	Published	No.	Title	Published
1.	Sewing Table	Feb., '27	51.	Clipper Ship Model—Hull	*Oct., '26
2.	Smoking Cabinet	*Mar., '27	52.	Clipper Ship Model—Details	*Oct., '26
3.	End Table	*Apr., '27	53.	Clipper Ship Model—Rigging	*Oct., '26
4.	Kitchen Cabinet	*May, '27	54.	Five-Tube Radio Set	*Oct., '26
5.	Shaving Cabinet	June, '27	55.	Five-Tube Set—Details	*Oct., '26
6.	Archer, Gate and Seats	July, '27	56.	Bird and Animal Toys	Dec., '26
10.	Porch Swing	Aug., '27	57.	Constitution Ship Model—Hull	Jan., '27
11.	Bench and Tilt Table	Sept., '27	58.	Constitution—Rigging	Feb., '27
12.	Electric Washer	Oct., '27	59.	Constitution—Rigging	Feb., '27
13.	Toy Wagon	Nov., '27	60.	Walsh Dresser	Mar., '27
14.	Christmas Toys	Dec., '27	61.	Viking Ship Model—Hull	Apr., '27
15.	Workshop Bench	Jan., '28	62.	Viking Ship—Details	Apr., '27
16.	Inlaid Radio Cabinet	Feb., '28	63.	Toy Motor Boat—Hull	May, '27
17.	Cedar Chest	*Mar., '28	64.	Toy Motor Boat—Details	May, '27
18.	Phone Table and Stool	*Mar., '28	65.	5th Simple Block Puzzles	June, '27
19.	Grandfather's Clock	*Apr., '28	66.	Ship Model Weather Van.	July, '27
20.	Plot Top Desk	*Apr., '28	67.	Toy Model of Lindbergh's New York-to-Park Plane	Aug., '27
21.	Colonial Desk	*Apr., '28	68.	Modesty Rock Table and Rush-Treasure Table	Sept., '27
22.	Cabinet and Desk	*Apr., '28	69.	Flying Model (1-ft.) of Lindbergh's Monoplane	Oct., '27
23.	One Car Garage	*May, '28	70.	Console Radio Cabinet	Nov., '27
24.	Gatefold Table	June, '28	71.	Console Radio Cabinet—Details	Nov., '27
25.	Cannon Balling Outfit	July, '28	72.	Colonial Doll's House	Nov., '27
26.	Baby's Crib and Bed	Sept., '27	73.	Furniture for Doll's House	Dec., '27
27.	Kitchen Cabinet Table	Oct., '27	74.	Santa Maria Ship Model—Hull	Dec., '27
28.	Pullman Play Table	Nov., '27	75.	Santa Maria Ship Model—Details	Dec., '27
29.	Toy Toy Chest, etc.	Dec., '27	76.	Santa Maria Ship Model—Rigging	Dec., '27
30.	Tool Cabinet, etc.	Jan., '28	77.	Pier Cabinet and Book Shelves	Jan., '28
31.	Sewing Cabinets	Feb., '28	78.	Simple Treasure Chests	Feb., '28
32.	Chicago Game Table	Mar., '28	79.	Popular Science Electric Radio Set	Feb., '28
33.	Dining Alcove	Apr., '28	80.	High Power Unit for Electric Radio Set	Mar., '28
34.	Garden Trellis	May, '28	81.	Low Power Unit for Electric Radio Set	Apr., '28
35.	Simple Radio Cabinet	Oct., '26	82.	Single Stick Tractor Airplane Model (10-in. wing)	Mar., '28
36.	Rush-Button Chair	Nov., '26	83.	Mayflower Model—Hull	Apr., '28
37.	Simplified Bookcase	Dec., '26	84.	Mayflower—Details	May, '28
38.	Small Drop-Lead Table, Shaver's Style	Jan., '28	85.	Mayflower—Rigging	June, '28
39.	Saloon Chest	*Feb., '28	86.	Racing Airplane Model (10-in. twin-pusher type)	May, '28
40.	Small Drop-Front Desk, Shaver's Style	Mar., '28	87.	Seaplane Model (10-in.)	June, '28
41.	One-Tube Radio Set	May, '28	88.	Simple Modernistic Stand and Bookcase	Aug., '28
42.	Three-Stage Amplifier	*June, '28	89.	Brownie Scale Flying	Aug., '28
43.	Four-Tube Receiver	*July, '28	90.	Brownie Scale Flying	Aug., '28
44.	Pirate Ship Model—Hull	*Feb., '26			
45.	Pirate Ship—Details	Mar., '26			
46.	Galleon Model—Hull	May, '26			
47.	Galleon Model—Details	May, '26			
48.	Sailing Yacht Model	*July, '26			
49.	Bureau Cabinet	Aug., '26			
50.	Airplane Model (Flying)	*Sept., '26			

Blue Print Department
POPULAR SCIENCE MONTHLY
250 Fourth Avenue, New York

I enclose _____ for which please send me the blue print, or blue prints I have underlined above.

Name _____

Address _____

More room in the Kitchen



This enclosed porch, built with Celotex, makes an ideal breakfast room and a handy place for the ice box

WITH Celotex, you can turn open porches into kitchen additions of sun porches, at little cost.

You can change damp uninsulating basements into cheerful recreation rooms for the entire family.

You can make waste attic space into a comfortable extra room for the maid or chauffeur, a study for Dad or a den for the boys.

Insulates Rooms

Celotex, made from long tough fibres of cane, stops extreme heat, cold and dampness—makes rooms more livable all year 'round.

It comes in big strong boards that are light and easy to apply. So with hammer, nails and saw you can make these home improvements yourself.

All reliable lumber dealers can supply Celotex. Send in the coupon below for two free illustrated booklets on ways to use Celotex around the house. The Celotex Company, Chicago, Ill. In Canada, Alexander Murray & Co., Ltd., Montreal.

CELOTEX

INSULATING CANE BOARD

THE CELOTEX COMPANY

643 North Michigan Avenue, Chicago, Ill.

Please send me free your illustrated booklets "Year Round Comfort with Fuel Saving" and "Artistic and Useful Things You Can Make at Home with Celotex."

Name _____

Address _____

City _____ State _____

Outboard Racing Secrets

(Continued from page 61)



A fast hydroplane driven by a powerful outboard motor. Speeds up to 35 miles an hour are possible under the most favorable conditions with this type of hull in combination with one of the large heavy-duty motors.

Outboard Motor Speed Table

(Speed Range in Miles an Hour)

Type of Boat (One or Two occupants)	Large Twin Class C (4-cyl. Motors)	Class B Motors	Standard Motors	Light Twin Heavy Duty Single-cyl.	Light Single-cyl.	Light Single-cyl.
Racing hydroplanes, sea sleds, etc., 8 to 16 ft. long	30-35	20-25	15-25	14-18	Not suitable	Not suitable
Square stern canoes, . . .	15-25	12-20	10-18	9-15	8-12	6-8
Light round-bottom or V-bottom boats, . . .	10-22	10-20	8-18	9-16	6-11	6-8
Heavy round or V-bottom boats 12 to 20 ft. long, . . .	8-18	6-15	5-12	4-11	3-8	3-7
Flat-bottom boats 12 to 16 ft. long, . . .	8-18	6-12	5-12	4-10	3-8	3-7
Dinghies or tenders 7 to 12 ft. long, . . .	Not suitable	6-12	9-14	6-8	6-8	3-6

As will be seen from this tabulation, speed depends as much on the hull as upon the motor, but the table will serve to approximate the possibilities of any hull with one of the several motors listed.

filling funnel; it should be strained through chamois so that there is no chance for dirt or water to put the carburetor out of business. Many a race has been lost through neglect of this simple precaution.

The driving gears, which are housed in just forward of the propeller, should be given careful and frequent attention to see that they are lubricated with the right grade of gear grease, both to keep the wear on the gears at a minimum and to keep out the water, which would soon ruin the gears. The cooling system also should be checked to see that the water is circulating properly, as a too hot motor is unlikely to show maximum speed. Some motors, however, have a tendency to run too cool, although this is not common during the summer months.

The wheel or propeller furnished by the motor manufacturer is designed for the best service under average conditions. It is sometimes advisable to purchase a special racing wheel, which will let the motor turn up to its highest number of revolutions per minute. Most manufacturers will advise you as to the size of wheel you should have for your type of boat, and, as they have experimented more than the average user, their recommenda-

tions are to be depended upon implicitly.

Now that you have the right motor and a speed type of hull, there are two or three more details that should be given attention. It is essential that the wheel have free water to work to its best efficiency. This means that the motor should be so hung on the stern of the boat that no part of the boat's bottom interferes with the flow of water in an unbroken stream to the propeller. To accomplish this it is customary to cut a notch in the stern for the motor or to use a long-shaft motor if the standard length does not happen to be correct for a given boat.

Remember that the propeller should be completely submerged, both when the boat is at rest and when running at speed, otherwise the wheel will suck air and merely churn up the water. To most of the large motors is attached just above the propeller what is known as a "cavitation plate." This helps considerably to keep the propeller working in solid water under all conditions.

Distribution of weight in the boat is an important matter if top speed is expected. The motor, weighing anywhere from fifty to one hundred pounds, is as far aft as possible when it is clamped in the usual position on the

(Continued on page 93)



Outboard Racing

(continued from page 92)

stern. Now, if the operator also sits on the stern seat, the boat is quite likely to run along with its stern in the air. Most of the modern high-speed outboard hulls are designed so that as they pick up speed they will flatten out and run at a slight angle to the surface of the water, but it is a wise precaution to arrange the motor with tiller lines or an extra long steering handle so that the operator may trim the boat to suit running conditions. This may be accomplished in a number of ways, but the simplest is to make an extension handle of brass tubing. Remote throttle control is also highly desirable.

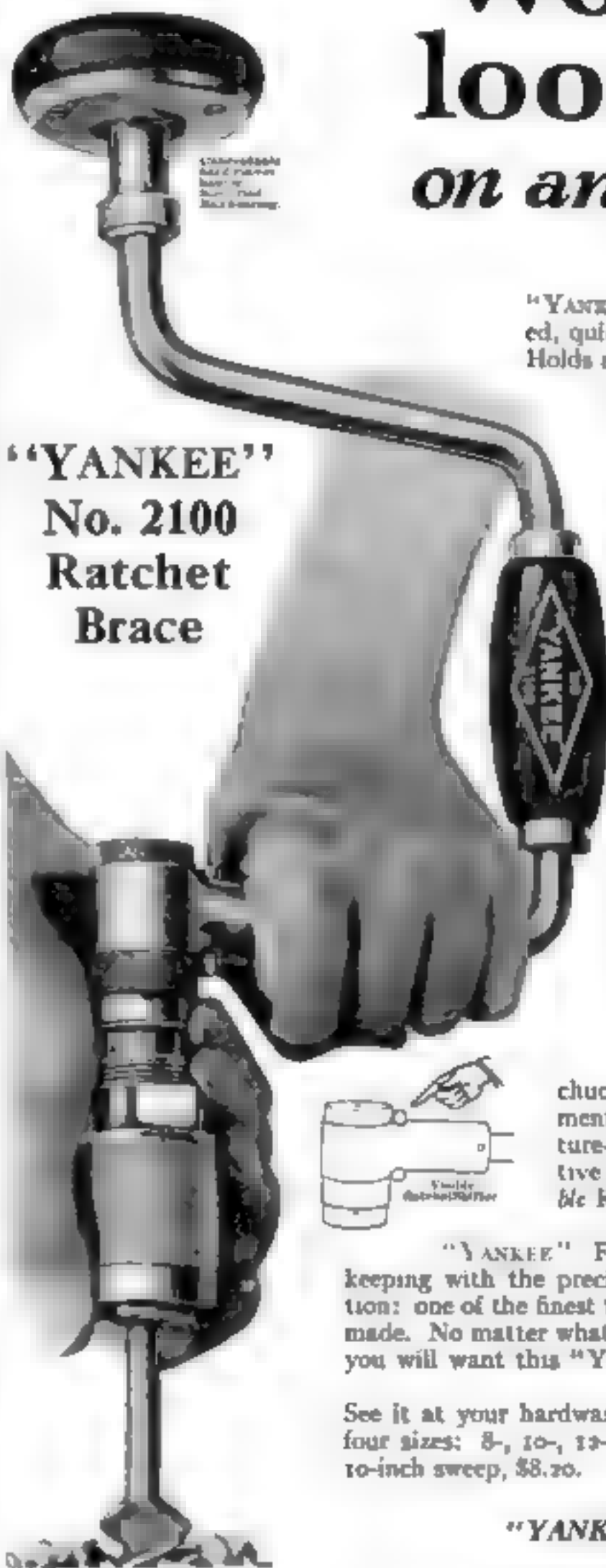
Air resistance plays an important part in cutting down the speed of any boat, automobile or airplane, and much attention has been given to this phase by designers of aircraft and racing automobiles. The speed boat must necessarily be streamlined so far as possible. The fact that the outboard craft is only a few inches above the surface of the water helps to solve this difficulty. No unnecessary projection to catch the wind should be allowed above the deck line of the boat, and the driver should be low in the hull, both to keep the weight low and also to cut down wind resistance.

IT IS sometimes helpful to cover the forward part of the boat with a light canvas deck, if the boat is of the open type. The canvas may be stretched over battens. This serves to keep out any water that may find its way over the bow and also to shoot the air over the after part of the boat and the driver.

When many high-speed boats are maneuvering in a race, the water becomes choppy, even on a still day. The pitching of the boat cuts down its speed because of the increased surface resistance and the fact that the propeller races in the air. It seems needless to say that the smoothest water should be chosen to get top speed.

Present rules under which outboard races are being run this season call for mufflers, so it seems unnecessary to mention the use of the cut-out. It is doubtful if mufflers build up enough back pressure to make any appreciable difference in speed, but the put-put of the high-speed outboard is so objectionable to residents ashore that hardly anyone now uses the cut-out.

If the reader does not already own an outboard motor boat, he will be interested in making a good selection for his needs. There are so many different types that it is a good *(Continued on page 120)*



"YANKEE" No. 2100 Ratchet Brace



"YANKEE"
Tool Book. Free
Write us for this book,
illustrating the uses of
many important tools.

Won't loosen on any bit

"YANKEE" Chuck.—New, patented, quick centering. Ball bearing. Holds any bit accurately. Round, square, taper. Won't loosen; bit can't pull out in work. Two-jaw. Capacity up to $\frac{1}{2}$ -inch round and $\frac{3}{4}$ -inch square.

"YANKEE" Handles.—Hard rubber. Unbreakable. Won't warp, shrink, crack, or bind. Top handle steel clad, ball bearing. Sweep handle held by patented "Yankee" method: keeps caps in place; prevents excessive handle play.

"YANKEE" Famous Ratchet.—Smooth as the stemwind of a watch. Yet unbreakable! No need to hold

chuck, on ratchet movement. Dust-proof. Moisture-proof. Quick, positive easy-acting and visible Ratchet Shifter.

"YANKEE" Finish.—Strictly in keeping with the precision of its construction: one of the finest tools of any kind ever made. No matter what bit-braces you have, you will want this "Yankee" Brace.

See it at your hardware dealer's. Made in four sizes: 8-, 10-, 12- and 14-inch. Price, 10-inch sweep, \$8.70.

"YANKEE" Bit Extension No. 2150

Holds bit in socket—No jaws to break. No loosening and pulling out of bit in work. Can't jam. Fits any brace. Follows through. Stands abuse. Lengths, 15, 18, 21, 24 inches. Prices, \$1.25 to \$1.40.

NORTH BROS. MFG. CO., Philadelphia, U. S. A.

"YANKEE" TOOLS

Make Better Mechanics



The Professional Touch

A rack for your files gives a professional touch to your workshop. A great many mechanics keep files that way.

In your rack, for cutting and shaping metal surfaces you should have a Nicholson Flat Bastard File; for sharpening saws a Nicholson Slim Taper File; for enlarging holes a Nicholson Round Bastard File; and for drawfiling and finishing a Nicholson Cabinet File.

For wood working and cabinet making you should have a Nicholson Cabinet File and a Nicholson Wood Rasp. Nicholson Files can be obtained from practically any hardware or mill supply dealer.

NICHOLSON FILE COMPANY
Providence, R. I., U. S. A.

NICHOLSON
USA

— A File for Every Purpose

How to Drive Nails to Make Them Hold Fast

By EMANUEL E. ERICSON

HAMMER and nails are in common use in every household. Yet driving nails, the commonest of all mechanical operations, is not often done in such a way as to get the full holding power of the nails. A few plain facts about nails and their uses would, if they were observed, decrease the difficulties encoun-



Fig. 1. Mr. Ericson demonstrates the proper way to use a hammer when driving a nail.

tered and save much effort and subsequent disappointment in the failure of joints.

The proper way to hold a hammer is the first important thing to learn. The amateur has the natural feeling that the less of the handle he uses, the less likely he is to miss the nail. The truth of this is not borne out in practice, however, for after one has become accustomed to holding the hammer handle at the end,



Fig. 2. (Left) Handling a hammer for straight driving.



Fig. 3. "Toe-nailing" at right calls for more practice.

as shown in Fig. 2, he will miss the nail if he tries the former method. It is safe to assume that the manufacturers of any good hammer know something about the best length of handle to use.

The angle of the hammer or the "hang" of it will have to be sensed from experience. It will not (Continued on page 95)

How to Drive Nails

(Continued from page 84)



Fig. 4. A block under the claws of the hammer is necessary in drawing long nails.

take long before a person will automatically hold his hammer handle just low enough as the hammer strikes the nail.

Sometimes an otherwise good hammer seems to slide off the nail. At such a time it will be a good thing to rub the face of it on a piece of fine sandpaper, for it has probably become greasy.

For ordinary use, a bell-faced hammer (one with a convex driving surface) will prove the most satisfactory, it will not mar the surface when the nail is "driven home." The weight of the hammer is partly a matter of choice, although the tendency of the amateur is to try to use a hammer that is too light. From 14 to 16 oz. is the common range, depending upon the required use.

Sharp, decisive blows will produce best results, and confidence on the part of the driver will keep nails from bending.

"Toe-nailing," Fig. 5, is somewhat more difficult than straight driving. For this it is better whenever possible to start the nails before the pieces are in the final position. Care must be taken not to slant the nails too much or they will not reach the second member properly.

This is a common error of the amateur. After some practice one can drive the nails very close in a corner without scarring the wood.

Pulling a nail requires just as much care as driving one. The extra large supply of hammer handles at the hardware store is kept principally for those who have not



Fig. 6. Skilled malleting will draw shaven boards into place.

learned how to pull nails. The main thing to bear in mind is the necessity of keeping the fulcrum near the nail. This is taken care of by the shape of the hammer when the head of the nail is close to the wood as in (Continued on page 96)



Fig. 5. How the nail set should be held.



To new shavers and old:

Make this 10-day test before you decide you've found the ultimate in a shaving cream that suits your face

GENTLEMEN

When we decided to go into the making of a shaving cream we were told that men were fickle—that they changed shaving creams as easily as they changed their shoes.

But this we believe is wrong. For in the few years this new shaving cream has been sold, we find there is a peculiar loyalty to it. We find the younger generation is going Palmolive when it comes to shaving.

And we know for fact that the great majority of those who take our 10-day test, remain wedded to it.

If you do not know Palmolive Shaving Cream, why not send the coupon now and give us a chance to win you? You'll thank us when you know the joy it brings. And the burden lies entirely with us to prove our claims.

We first asked 1000 men

We sought, first the shortcomings of other shaving methods before we even started to create Palmolive Shaving Cream.

PALMOLIVE RADIO HOUR. Broadcast every Friday night—from 10 to 11 p. m., eastern time; 9 to 10 p. m., central time—over station WEAJ and 32 stations associated with The National Broadcasting Company.

35c

With the new unbreakable
Bubble top



2074

To add the final touch to shaving luxury, we now present Palmolive After Shaving Lotion—especially for men. Does it shave—leaves the skin smooth and fresh and gives that well-groomed look. Try the sample we are sending free with the can of Shaving Cream. There are new delights here for every man. Please let us prove this to you. Clip the coupon now.

One thousand men's views were asked, their answers analyzed.

Then our world-famous laboratory put its most skillful men on the problem to exceed these expectations. Time after time they failed in one way or another—119 times in all. Then success came.

These 3 important features

1. Multiplies itself in lather 150 times.
2. Softens the beard in one minute.
3. Maintains its creamy fullness for 10 minutes on the face.
4. Strong bubbles hold the hairs erect for cutting.
5. Fine after-effects due to palm and olive oil content.

Now make the trial, please

No doubt your present shaving preparation suits you, yet there may be a better way. We've tried to find one for you, and will thank you to give it a test. Just send the coupon now.

10 SHAVES FREE

and a can of Palmolive After Shaving Lotion

Simply insert your name and address and mail to Dept. B-154, Palmolive Sales, Inc., Chicago, Ill.

Residents of Wisconsin should address Palmolive, Milwaukee, Wis.

Please print your name and address



5

BIG, NEW FEATURES

1

Two Bullet Headlights. Double lights—greater safety.

2

Generator Controller. Quick, handy control of current output.

3

Electrical Panel. Includes ammeter, parking light, and switches.

4

4-Tube Muffler. Makes exhaust wonderfully quiet.

5

Clear-the-way Horn. High frequency—penetrating, pleasing note.

1929 MODELS BY HARLEY-DAVIDSON

BBETTER equipped, better looking, better performing than ever, the 1929 Harley-Davidsons are ready now to show you the latest and finest in motorcycle design. Never before such power—such comfort—such convenience!

Motorcycle enthusiasts everywhere are flocking to the local Harley-Davidson Dealers to see the new models.

Join them there! Let your local dealer show you how much motorcycle you can buy for little money, and on easy terms. Let him give you a demonstration. If you aren't a rider already, he'll gladly teach you to ride, free.

Write us—on the coupon—for our new literature.

HARLEY-DAVIDSON MOTOR COMPANY
Department P. 5. Milwaukee, Wis.

Demand for Harley-Davidson Motorcycles and Package Trucks offers business men great opportunities as dealers. If interested, write us a letter—address Dept. A 1.

1929 Single—the famous 50 mile-a-gallon solo mount—has all the new Harley-Davidson features. Sells at \$231 f. o. b. factory.



HARLEY-DAVIDSON MOTOR CO.,
Dept. P. 5., Milwaukee, Wis.

Interested in ☐ Twins; ☐ Single. Send literature.

Name _____

Address _____

Old Stove Bowl Used as Temporary Forge

IN BUILDING a racing car at home, it became necessary to heat some heavy iron bars. The cost of a forge was prohibitive for this one job, so a forge was improvised on the spot.

An old heating stove bowl, which was badly cracked, was found in the scrap



How a forge was quickly improvised by lining the bowl of a discarded stove with clay and using a vacuum cleaner as a blower.

pile. A hole was made in the side where it was burned out and a piece of 1½-in. pipe inserted. The bowl was then lined with clay. The other end of the pipe was fastened to a vacuum cleaner with a blower attachment.

In no time we had a fire that would burn up the world. The flame was so fierce we had to insert a shutter valve to regulate the air—JACK COHEN.

How to Drive Nails

EDWARD F. HARRIS

Fig. 1. In this way great pulling power is applied by only a few pounds of push, and the handle is safe.

It is after the nail comes up a distance and the fulcrum shifts toward the face of the hammer that the handle is in danger, both from less mechanical advantage and from the fact that the pull ceases to be vertical. At such a time the wise operator will take time to find a block to put under the hammer as shown in Fig. 4.

There is a trick in "setting" nails that it takes a little time to develop. Most amateurs make a big ugly hole around the head. Figure 5 shows the proper way to hold the nail set. Steady it with the fingers against the wood so that it will not slip, then make a decisive blow so that the nail goes down below the surface. After that it is easy to drive it as deep as desired without trouble.

In Fig. 6 is shown how to draw pieces into position by the use of nails. The nail is started at an angle from the higher piece, with a crevice left open between the two until the nail has caught the second member. When the nail is driven in, the joint is closed and the lower piece is drawn up into position.

It is well to bore a hole in the end of the hammer handle with a ¾-in. auger bit and fill it with soap. After dipping the tip of nails into the soap, the driving becomes much easier.

Unique Triple Stand Combined with an Electric Lamp

THE combination electric light and triple stand illustrated in Fig. 1 is a distinctly novel piece of furniture for the amateur woodworker who wishes to build something that cannot be duplicated in a furniture store. The trays may be used for smokers articles, books and papers, or sewing materials. The stand would also serve as a corner "whatnot" for the display of curios or art objects, especially as the shelves may be well lighted. As an alternative design, the shelves may be omitted and the top finished as at A, Fig. 1.

Mahogany, oak or any wood of medium hardness may be used. The middle post

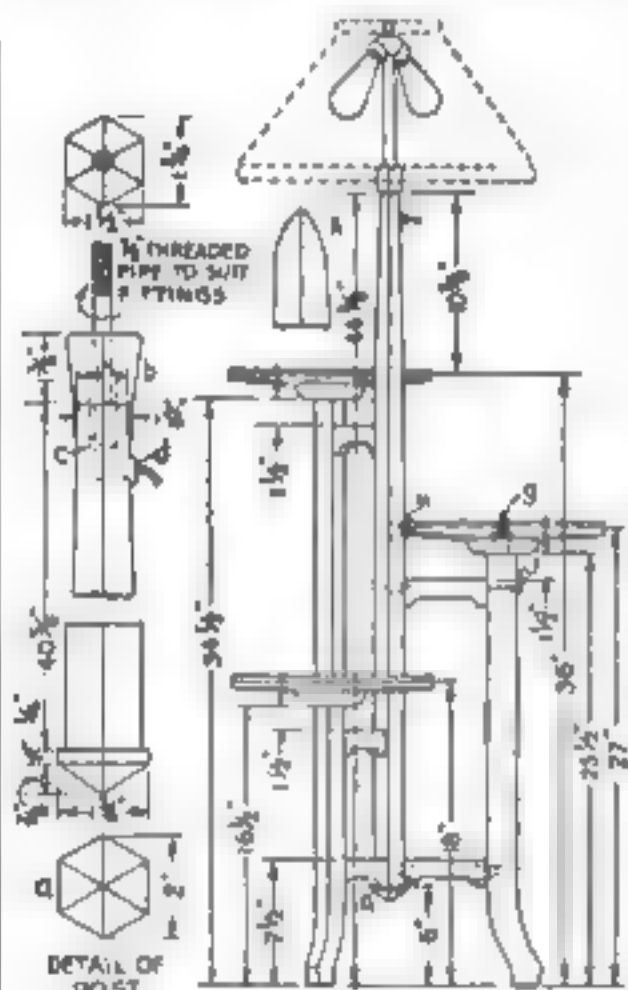


Fig. 1 Side view of the completed stand and a larger detail of the central post.

should be made of a $1\frac{1}{2}$ by $1\frac{1}{2}$ in. piece, planed six sided and tapered from the top shelf to 1 in. across the flats at the top.

The pendant base a should be six-sided and fastened with brads after the stand has been assembled. The top b may be fastened with a $\frac{1}{2}$ -in. dowel c and glue; the $\frac{1}{2}$ -in. holes to receive the threaded pipe and wire d may be bored and the pipe and wire put in after the stand is finished.

Make the three legs for the stands and the six stretchers, and cut the three shelves roughly. Make the lip e, Fig. 2, of $\frac{1}{4}$ -in. wood, cut in half circles to the correct size inside and $\frac{1}{2}$ in. wide, round the inner edge, smooth and sandpaper the top of the shelf, locate the lip, glue it in place, and work the shelf with the lip down to the desired size. Taper the lower side of each shelf to (Continued on page 100.)



The Fine Art of Sharpening Edge Tools

HOME CRAFTSMEN have learned a lesson from experienced carpenters and cabinet makers. To keep their tools up to perfection with smooth keen-cutting edges they use and heartily recommend the

Carborundum Combination Stone

- because it is made of Carborundum, the manufactured abrasive—hardest and sharpest.
- because it does "double duty"—coarse side takes out nicks and quickly brings back the edge, while the fine grit side is used for giving the tool edge the finishing touch.

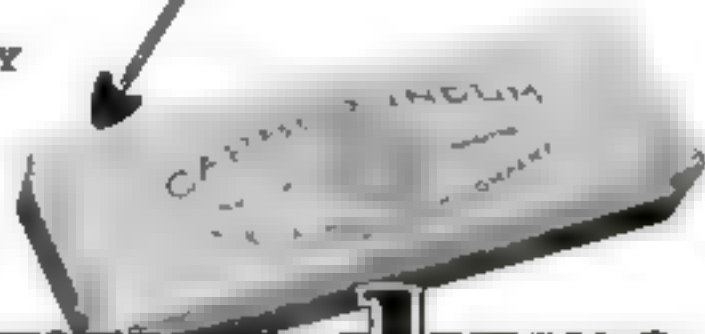
Order from Your Dealer

THE CARBORUNDUM COMPANY
NIAGARA FALLS, N. Y.
CANADIAN CARBORUNDUM CO., LTD.
NIAGARA FALLS, ONT.



Carborundum is the Registered Trade Mark used by The Carborundum Company in all its products. This Trade Mark is the symbol of the quality of the Carborundum Company.

Send for Booklet:
"How To Sharpen Tools"



Carborundum

ABRASIVE PRODUCTS



More than ocean waves are needed...to rid him of that half-clean look

A DASH through the surf, a swim to the raft—even then, she notices, his face still wears that sallow, half-clean look!

For more than ocean waves are needed to make his face really clean. Pore-dirt hides in every face.

All day long—on the street, even indoors—the air teems with millions of tiny specks of sooty gray. These specks sneak right into the pores—get jammed right under the surface of the skin.

Once under, pore-dirt is there "for keeps"... unless you massage it free.

That is why Pompeian Massage Cream was made. That is what this cream so clearly proves to be true!

Goes in pink—rolls out GRAY
Below, in the circle, is a photograph taken under the lens of a powerful



Every inch of air, says the U. S. Weather Bureau, is alive with millions of tiny specks of dirt. Motor puff, chimney smoke, dusty streets—no one escapes!

microscope, showing a section of any ordinary man's skin after Pompeian Massage Cream has gone to work!

See the dark marks? They're dried pellets of cream laden with pore-dirt now rolled free! Now the skin is clean—gloriously clean.

Try it on your own skin! After a hard day's work let this bracing cream bring to your face the freshness of a chap who's just had a few hours' nap. There's nothing like a pick-me-up Pompeian massage to make your friends say, "My, but you sure look well, old man!"

**Thousands of men benefit
by our FREE offer**

Pompeian is 60 cents at any toilet goods counter. You're welcome to test it free. Thousands of men have been convinced this way. Please take advantage of the coupon. Mail it... now!

Step out tonight with a face really clean—Pompeian clean! So fresh and ruddy that she will say, "My, but you sure look well tonight! You never looked better in all your life!"



POMPEIAN MASSAGE CREAM

The Pompeian Company
395 Fifth Ave., New York
In Canada: 72 St. Andrew St. Montreal
Gentlemen: Please send me a free trial tube of Pompeian Massage Cream enough for two cleansing, invigorating facial massages.

Name _____

Street _____

City _____

Dept. 901-1

State _____

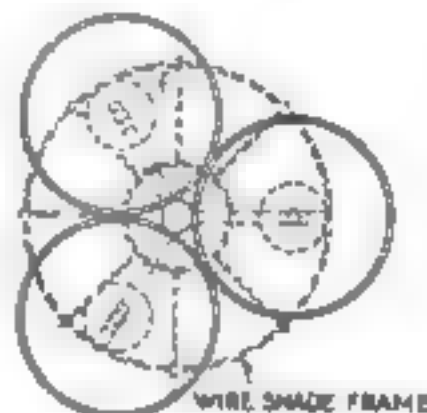
Unique Triple Stand

(Continued from page 87.)

$\frac{3}{4}$ in. thickness at the edge, including the lip. Leave the central portion $\frac{1}{4}$ in. thick where the 4-in. round block *f* is to be glued.

Bore a $\frac{3}{4}$ -in. hole to receive the pin *g*, Fig. 1, though two $\frac{3}{4}$ -in. dowels may be used if preferred, which will allow the top of the leg to be made square.

Note that the screw holes *h*, Fig. 2, of the stretchers are driven slantingly each



DETAIL OF SHELVES



IF DESIRED STRETCHERS MAY BE FASTENED WITH 3" NO. 10 SCREWS AS AT *j* INSTEAD OF DOWEL AND SCREW



Fig. 2. Plan view of the stand and the method of constructing the shelves and stretchers.

way to allow a $1\frac{1}{2}$ in. No. 11 screw to be driven easily. Glue each leg with its stretchers to the post. Fit each shelf in place and drive brads through the shelf into the post as at *k*, Fig. 1.

Sandpaper and prepare the wood for finishing in any desired way. The light fittings may be secured of any electrical supply company. The shade frame may be bought or made of $\frac{1}{4}$ -in. coppered soft iron wire and covered with silk, parchment or other materials, and the whole supported from the top of the double light socket.—C. A. h

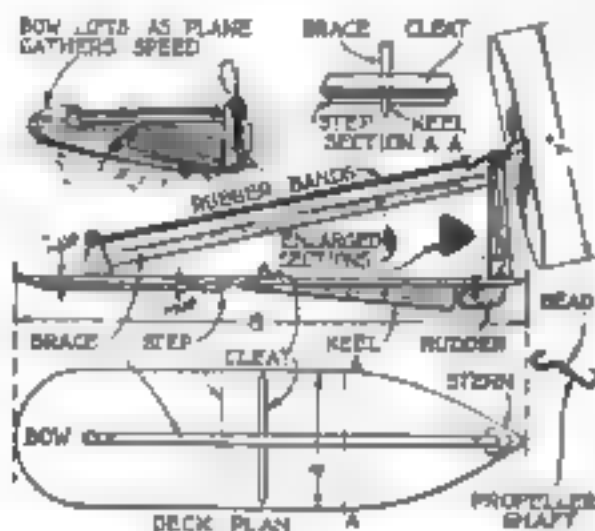
A BADLY misshapen and hardened paint brush may respond to acetone or other cleansing treatment, but usually the result is far from satisfactory. Often badly bent bristles may be remedied, after the paint has been cleaned out, by soaking them in warm water until they become soft and flexible. Brush the moisture out, draw the bristles to the desired shape at the end or edge, and fold stout wrapping paper around them to hold them in place until they have dried thoroughly. Rinse the brush in clean water before using it to remove all traces of soap. If the bristles are still out of shape, repeat the wrapping paper process.

Toy Hydroplane Travels at Great Speed

By H. SIBLEY

ITS great power and extreme lightness give this toy hydroplane surprising speed. It is literally a mosquito among water craft.

Use $\frac{3}{8}$ -in. white cork pine or similar light, soft wood for all parts except the rear propeller support, which is whittled from $\frac{1}{4}$ -in. stock in triangular cross section, tapered toward the top. Round the edges of hull, keel, rudder and other



How the hydroplane is made. Note the wide step under the forward part of the hull.

parts where streamlining will increase speed. The hull is very thin and will just support the power plant when idle, but under speed the bow will lift.

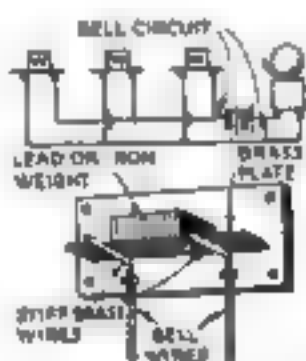
Give the entire craft two or three coats of shellac, well sandpapered, and see that the propeller shaft does not bind. Provision is made for a generous length of strong rubber bands, preferably of the kind sold for model airplanes, so that when well wound the hydroplane will travel for quite a distance.

A somewhat similar toy could be built with the propeller at the bow.

Fire Alarm Rings When Heat Melts Paraffin

IF YOUR home workshop is used by boys who may be careless about fire, or if you have any other reason for installing a fire alarm system, you can do so at a trifling expense.

All you need is a circuit of the type used for house door bells and one or more sensitive fire indicators so placed that they will be affected by any excessive heat. These indicators are merely two contacts, such as a pair of stiff brass wires or nails, bridged by a brass plate, which is held firmly against them by a weight as illustrated. Before being put into position, the brass plates should be dipped in melted paraffin so that they are insulated from the supporting wires or nails. In case of fire the paraffin melts, the circuit is closed and the bell rings.



Wiring diagram and one of the alarms.

WILLIAMS OIL-O-MATIC IS HEATING MORE HOMES THAN ANY OTHER OIL BURNER

WILLIAMS OIL-O-MATIC HEATING

Listed as Standard by the Underwriters' Laboratories

measures each drop of its efficient fuel!

EFFICIENCY is never left to chance in the new Model J Williams Oil-O-Matic. Like the carburetor of a fine motor car, Oil-O-Matic's exclusive, patented metering device measures out each drop of fuel, and feeds these drops, one by one, into the atomizing chamber.

This is why your Williams Oil-O-Matic *always* burns perfectly, cleanly, without a trace of soot or smoke. Such efficient combustion of heavy fuel oils would be impossible without Williams Oil-O-Matic's exclusive fuel metering and atomization.

Model J Williams Oil-O-Matic is Quieter, Simpler, Handsomer

Thousands upon thousands of Williams Oil-O-Matics have been in continual satisfactory use for years—many more than any other make. Enthusiastic Oil-O-Matic owners have assured us repeatedly that nothing finer could be desired. Yet the new improved Model J Williams Oil-O-Matic is more efficient.

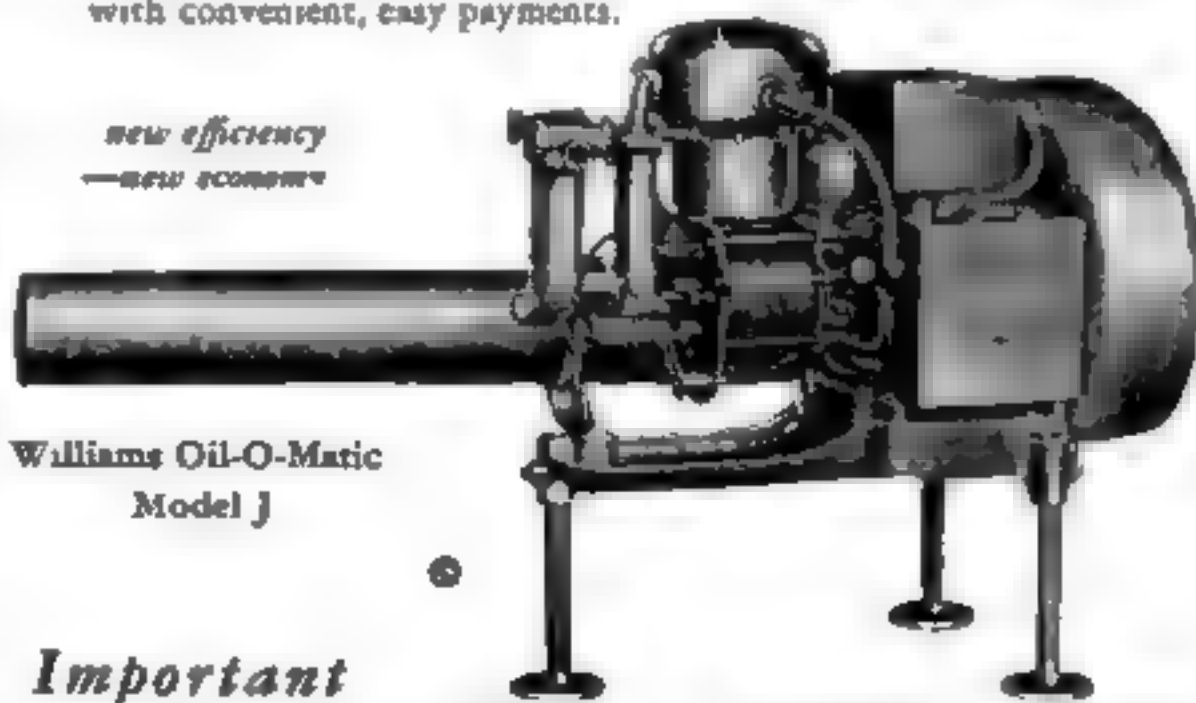
The new improved Model J Williams Oil-O-Matic is quieter, for mechanical noise has been removed—the ball-bearing motor is cushioned in live rubber—parts are machined to the utmost practical limits of accuracy—design has been simplified, making Model J a handsome, efficient heating unit.

Easy for Anyone to Own a Williams Oil-O-Matic

With Williams Oil-O-Matic convenience, with its even, constant temperature, why put up with the work and worry of coal heating? Why not save laundry, cleaning expense, doctor bills, and actual money by buying an Oil-O-Matic now.

The cost of Williams Oil-O-Matic Model J is extremely moderate. A small initial payment puts it to work in your home with convenient, easy payments.

*new efficiency
—new economy*



Williams Oil-O-Matic
Model J

Important Book FREE

The coupon at right will bring an interesting booklet, "Oil Heating at Its Best." It's free—no obligation. It contains the facts you ought to know before you buy any oil-burner. Clip and mail the coupon NOW.

Williams Oil-O-Matic Heating Corporation
Bloomington, Ill.

P. S. 8-9

Please send me your free booklet, "Oil Heating at Its Best."

Name.....

Street and Number.....

City.....

State.....

Two Tables for the Wood Turner

(Continued from page 100)



Fig. 5. Looking down on the inside top of the end table. The wood is bird's-eye maple.

Care must be taken to have them exactly alike. In making the ornamental book-trough end pieces, it is well to square them and cut the dados (grooves) before shaping the edges. Remember to plane and sandpaper the two boards which form the trough before laying out the dados into which they are to fit, so as to insure tight, workmanlike joints.

The shaped ends, as well as the upper rails, may be joined to the legs with dowels. Glue up the two ends of the table separately. When the glue is dry, complete the assembly of the framework by joining the two ends, the two long rails, and the two book-trough boards.

The top is fastened by means of cleats about $\frac{1}{4}$ in. square, screwed to the inside of the rails flush with their upper edges.

The choice of lumber and of the finish for both these projects is a matter of individual preference. The end table illustrated in Fig. 3 was made of maple and given an amber stain to imitate the color of antique maple. The stain was followed by a thin coat of shellac, which, when dry, was rubbed with No. 00 steel wool. A coat of clear brushing lacquer was next applied, and this was rubbed smooth with powdered pumice stone and crude oil. A coat of liquid wax was finally applied and rubbed to a soft sheen.

The seventh article in Mr. Hjorth's series on wood turning will appear in an early issue.

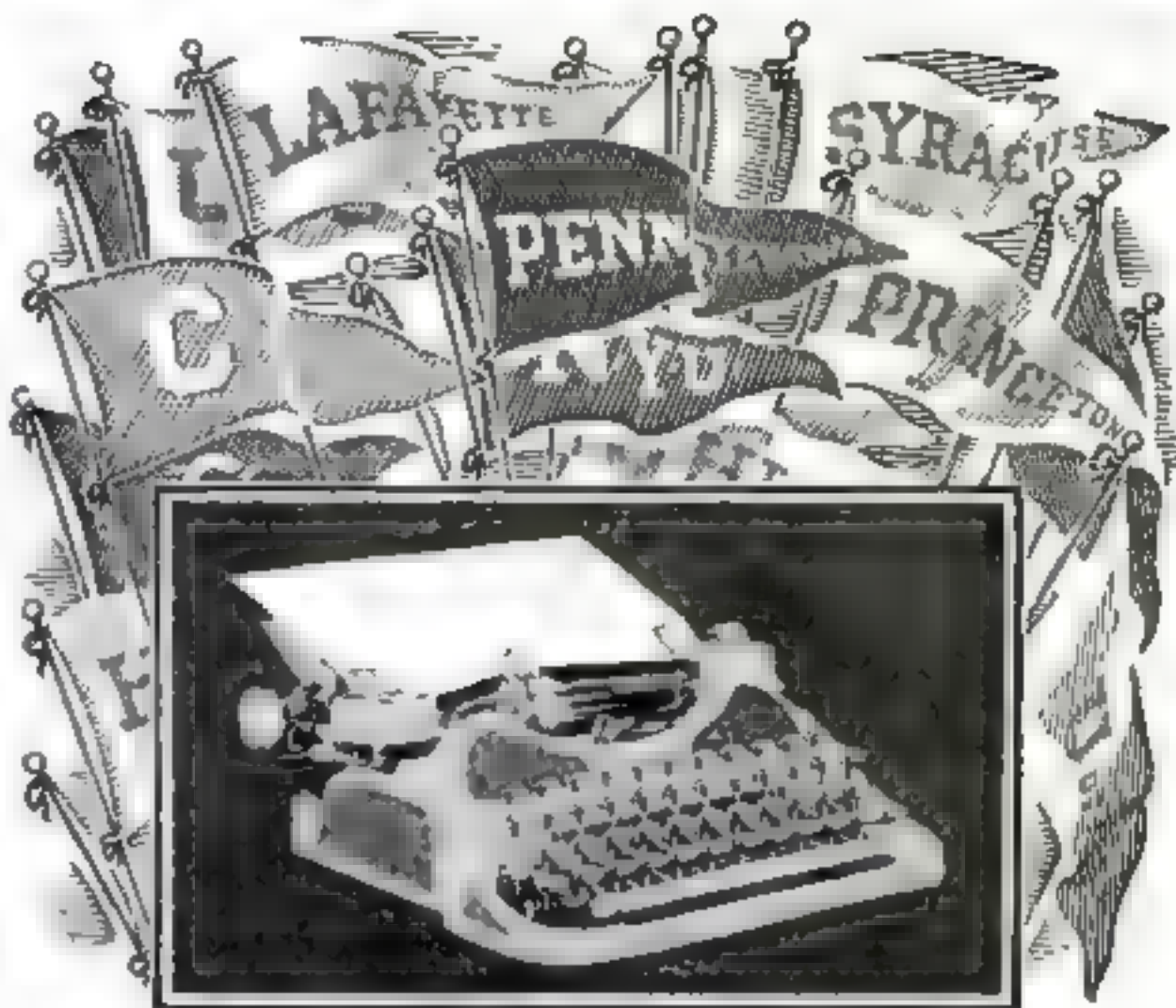
List of Materials

No. Pcs.	T	W	L.	Part
For Octagonal Table				
2	1 $\frac{1}{4}$	1 $\frac{1}{4}$	19 $\frac{1}{4}$	End
2	1 $\frac{1}{4}$	1 $\frac{1}{4}$	18 $\frac{1}{4}$	Support (plain and turned)
2	1 $\frac{1}{4}$	3	10	Feet
1	$\frac{1}{4}$	14	14	Support
1	$\frac{1}{4}$	23	23	Top
1 pair			8	Fast joint butt hinges
For End Table				
4	1 $\frac{1}{4}$	1 $\frac{1}{4}$	26 $\frac{1}{4}$	Legs
2	$\frac{1}{4}$	2 $\frac{3}{4}$	10	Ends
2	$\frac{1}{4}$	2 $\frac{1}{4}$	21	Ends
1	$\frac{1}{4}$	13	27	Top
2	$\frac{1}{4}$	8 $\frac{1}{4}$	8	Supports
1	$\frac{1}{4}$	4	21	Trough
1	$\frac{1}{4}$	4 $\frac{1}{4}$	21	Trough

All dimensions are in inches

Shield for Paint Spraying

NOT having a separate room to use when spraying homemade furniture and school projects constructed by boys, I found a good shield could be made from a large discarded window shade. I hung the shade on the wall about six feet from the floor so that it could be pulled down behind the painting table. It is particularly useful when spraying lacquer is being used. When a large shade cannot be obtained, two small ones will serve the same purpose. —GEORGE A. WILSON, Jr.



Why Corona leads in the Colleges

CORONA was the first portable to be used in college—and it has been the leader ever since because it fulfilled these three requirements of a college typewriter:

It is portable—light, compact, easily carried—easily lifted out of the way.

It is strong. Corona has an unequalled record for durability.

It is simple. Easy to use, easy to carry. Yet, in spite of compactness, lightness, simplicity, Corona is absolutely complete—standard 4 row keyboard—12-yard ribbon—full width carriage—every improvement modern skill can apply to a portable typewriter.

Beautiful Colored Coronas

Now, in addition to the standard black finish, we are offering a variety of attractively colored Coronas. See them at your local Corona store.

Buy on Easy Terms

Corona is the portable typewriter for you—at home—in business—or in college. Get one now. Pay for it in easy monthly instalments. The coupon will bring you full particulars. Mail it! Or phone our local representative and he will gladly leave a Corona at your home for you to examine at your leisure. No obligation.

L C Smith & Corona Typewriters Inc

Established 1903 Sales offices in principal cities of the world

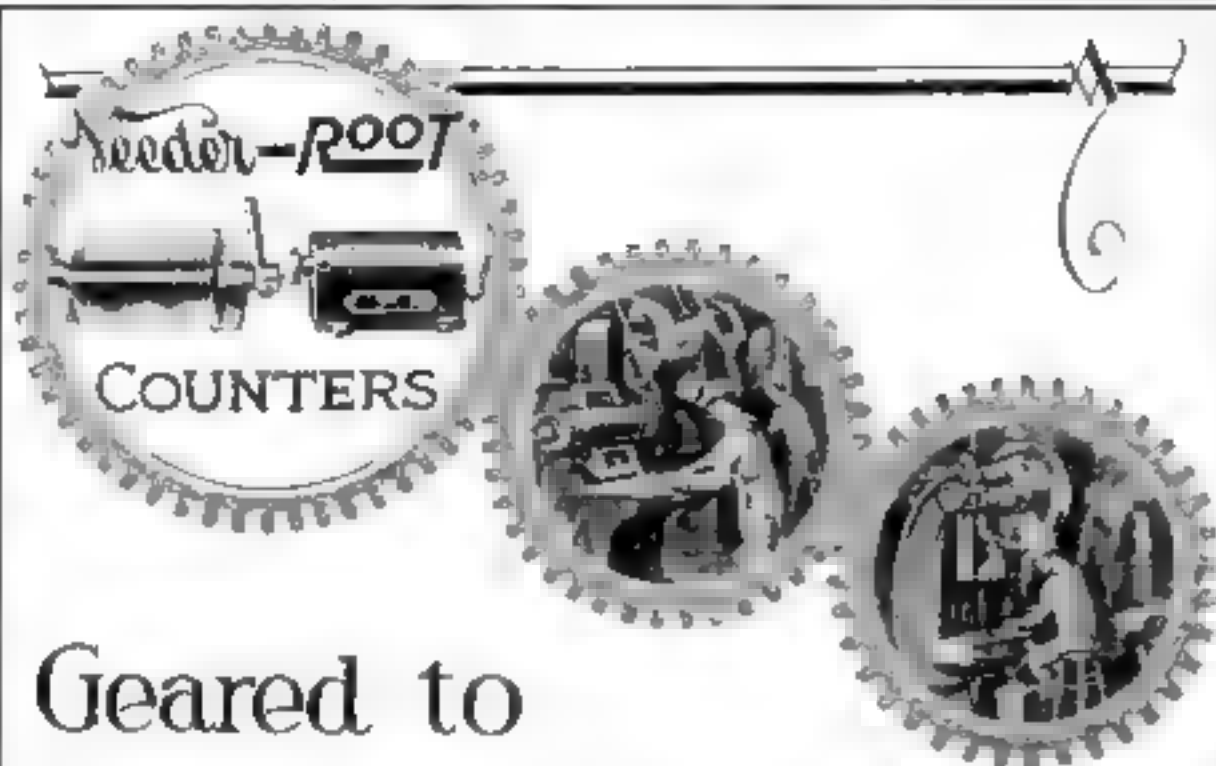
L C Smith & Corona Typewriters Inc
913 E. Washington St., Syracuse, N. Y.

Please send me your latest literature showing the new Duco finished Coronas in actual colors.

Name _____

Address _____





Geared to the Pace that PAYS

The pace that pays in machine operation is a little faster than "routine." Set it at a standard rate and keep it up by checking up with Counters. Step it up to a higher mark, as you develop a better machine or a better operator. Make the improvements register on a VEEDER-ROOT Counter.

Below is small Set Back Ratchet Counter which indicates one for each throw of the lever moving through an angle of 45 degrees. Reset to zero from any figure by turning knob. Price \$6.00. Also furnished in a Revolution Counter. Write for our brown book of Counters for all machines.



Set
Back
Ratchet
Counter

Veeder-ROOT INCORPORATED
HARTFORD, CONN.

PARKS

WOODWORKING MACHINES

Cabinet
Shop
Special
No. 10
\$290
with Motor



You ought to have a this handy Parks in your shop. Compact, complete machine designed like a big penitentiary outfit at 1/3 the cost. Fits in a corner of your basement. Shows any kind of cabinet or joinery work. Write for circular.

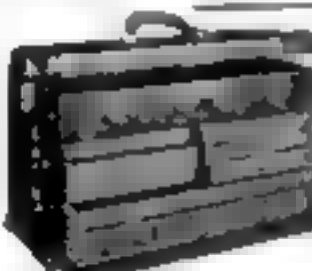
The Parks Woodworking Machine Co.
1547 Kew-Forest St., Cleveland, Ohio
Canadian Branch: 2nd North Street East, Montreal

"H & A"

The Better Wood Lathe

MADE IN U.S.A. This lathe is mounted on heavy structural steel and has a cast iron bed. It is a masterpiece of engineering and is built to last. It is the best lathe you can buy for the money. Write for details.

HESTON & ANDERSON
900 Western Ave., Fairfield, Iowa



Exceptional Quality
is found in every
Gerstner
Tool Chest
For Machinists and
Toolmakers

GERSTNER & SONS
257 Broadway, N. Dayton, Ohio

UP-TO-DATE 12' BANDSAW

Positively the latest development in band saw equipment. — In design, material and construction it is unexcelled. It features a 45-degree tilting table. The entire frame is of semi-steel. The steel-hardened ground shafts are microscopically accurate giving perfect speed and positive absence of vibration. For further information mail coupon below to-day

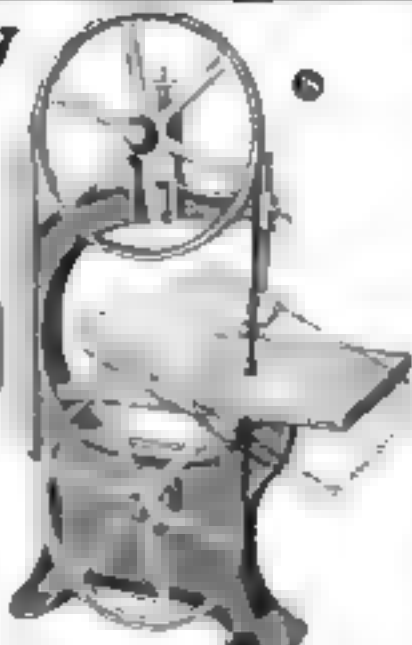
\$35.00

F.O.B.
Chicago
Ill.

This saw may be purchased on the time payment basis at \$39.00, \$10.00 down and \$10.00 per month. With this plan anyone can own a real Band Saw.

10-DAY FREE TRIAL

Use this saw for 10 days at our expense. If not satisfied, return, express collect.



MAIL
THIS

for full particulars to Up-to-Date Machine Works, 2915 S. Wabash Ave., Chicago, Ill.

Manager: Dept. 18. Without any obligation, please send me all particulars up to 10-day free trial. Also \$10.00 down payment offer.

Name _____
Address _____

Blueprints for Your Home Workshop

OUR blueprints can be obtained for 25 cents a sheet. In some cases there are two or three sheets to one subject. The blueprints are complete in themselves, but if you wish the corresponding back issue of the magazine in which the project was described in detail, it can be had for 25 cents additional so long as copies are available.

Popular Science Monthly,
250 Fourth Avenue, New York

Send me the blueprint, or blueprints, I have underlined below, for which I enclose _____

_____ dollars _____ cents

No.	Title	Described in Issues of	Price
1	Sewing Table	Feb., '22	25c
2	Smoking Cabinet	Mar., '22	25c
3	End Table	Apr., '22	25c
4	Kitchen Cabinet	May, '22	25c
5	Arboreal Gate and Bench	July, '22	25c
10	Porch Swing	Aug., '22	25c
11	Bench and Tilt Table	Sept., '22	25c
12	Tea Wagon	Nov., '22	25c
15	Workshop Bench	Jan., '23	25c
17	Cedar Chest	Mar., '23	25c
18	Phone Table and Stool	Mar., '23	25c
19	Grandfather's Clock	Apr., '23	25c
20	Colonial Desk	Apr., '23	25c
21	One Car Garage	May, '23	25c
25	Coffee Serving Outfit	July, '23	25c
27	Kitchen Cabinet Table	Oct., '23	25c
30	Tool Cabinet, etc.	Jan., '24	25c
31	Sewing Cabinets	Feb., '24	25c
33	Dining Alcove	Apr., '24	25c
34	Garden Trellises	May, '24	25c
37	Simplified Bookcase	Dec., '24	25c
39	Bureau Chest of Drawers	Feb., '25	25c
41	One Tube Radio Set	May, '25	25c
42	Three-Stage Amplifier	June, '25	25c
43	Four Tube Receiver	July, '25	25c
44-45	Pirate Ship Model	Feb., '26	50c
46-47	Galleon Ship Model	May, '26	50c
48	Sailing Yacht Model	July, '26	25c
49	Broom Cabinet	Aug., '26	25c
50	Airplane Model (Rise-off-ground tractor 36 in.)	Sept., '26	25c
51-52	Clipper Model, Soverign of the Seas	Oct., '26	75c
54	Five Tube Radio Set	Oct., '26	25c
55	Five-Tube Set Details	Oct., '26	25c
56	Bird and Animal Toys	Dec., '26	25c
57-58-59	Constitution Ship Model (Old Ironsides)	Jan., '27	75c
60	Welsh Dresser	Mar., '27	25c
61	Viking Ship Model - Hull	Apr., '27	25c
62	Viking Ship Details	Apr., '27	25c
63-64	Toy Motor Boat, 20 in. long hull	May, '27	50c
65	Simple Black Pucier	June, '27	25c
66	Ship Model Weather Vane	Aug., '27	25c
67	Toy Model of Lindbergh's New York-to-Paris Plane	Aug., '27	25c
68	Magazine Rack Table and Book-Trough Table	Sept., '27	25c
69	Flying Model 3 ft. of Lindbergh's Monoplane	Oct., '27	25c
70	Console Radio Cabinet	Nov., '27	25c
71	Console Cabinet Details	Nov., '27	25c
72	Doll's House	Dec., '27	25c
73	Doll's House Furniture	Dec., '27	25c
74-75-76	Santa Maria Ship Model, 16 in. long hull	Dec., '27	75c
77	Simple Pier Cabinet and Decorative Wall Shelves	Jan., '28	25c
78	Simple Treasure Chests	Feb., '28	25c
79	Electric Radio Set	Feb., '28	25c
80	High Power Unit for Electric Radio Set	Mar., '28	25c
81	Low Power Unit for Electric Radio Set	Apr., '28	25c
82	Simple Single-Stick Airplane Model 30-in.	Mar., '28	75c
83-84	Mayflower Model	Apr., '28	75c
85	Racing Airplane Model 35 in. twin pusher type	May, '28	25c
87	Seaplane Model 30-in.	June, '28	25c
88	Simple Modernist Bookcase	Aug., '28	25c
89-90	Bremen Scale Flying Model 3-ft.	Aug., '28	50c
91	Modern Folding Screens	Sept., '28	25c
92	Simple Baltimore Clipper Ship Model (8 in. long)	Sept., '28	25c

* Magazine only out of print

Name _____
(Please print name and address very clearly)

Street _____

City and State _____



Home Workshop Chemistry

Simple Formulas that
Will Save Time
and Money

CHEMISTRY furnishes a cheap and simple means for testing materials. While it is true that the old-fashioned buyer of such raw materials as paints and varnishes, bulk foods, steels and brasses, fuels and cements was satisfied to lay out his money "by guess and by gosh," the hard-boiled modern business man trusts no label but, before spending a nickel, sends a sample from each delivery to a commercial chemist.

Many home workshop chemists do not realize the number of simple chemical tests that they can apply to the numerous materials they themselves buy and so be enabled upon a smaller scale to spend their money as scientifically and economically as the buyer for a big corporation. Amateur chemists are sometimes frightened by the long names, such as "trinitrotoluol," "tetraethyl lead," and "sodium chloride" by which the professional chemist designates the solutions with which he works, but these names usually are worse than the substances.

For example, when a chemist tests distilled water from some drug store, service station, or laundry, to determine its suitability for use in radio or auto batteries, he employs two reagents—ten percent silver nitrate and concentrated thioglycolic acid. Any radio or auto fan can use the same tests. The silver nitrate can be obtained from a drug store. The thioglycolic acid is made by a manufacturer of kodaks and may have to be ordered through a photographic supply house.

TESTING water with silver nitrate shows whether or not it contains sodium chloride or table salt, which is the commonest contaminating element in water. This salt, when introduced into your battery, breaks down into hydrochloric acid, which attacks the plates. To run the test, pour about one quarter of a glass of the water to be tested into a clean jelly glass and then add a few drops of silver nitrate. Stir and look through the water against a black background. In the presence of even a trace of salt, a milky opalescence appears.

Thioglycolic acid is a standard reagent for testing for dissolved iron in water. Iron in battery water probably comes from iron pipes or from poorly tinned containers. In the battery it deposits on the plates and seriously decreases the discharging efficiency. To test for it, thoroughly clean the glass in which you tested for salt, and then pour into it the same amount of the water to be tested as in the previous test. Add one drop of thioglycolic acid and then half a teaspoonful of ordinary household ammonia. In the presence of even a trace of iron in the water, a tint ranging from pink to lavender will develop.—W. H. HAMMOND.

This FREE BOOK answers all questions—

Pledge to the Public on Used Car Sales

- 1 Every used car is conspicuously marked with its price in plain figures, and that price, just as the price of our new cars, is rigidly maintained.
- 2 All Studebaker automobiles which are sold as **CERTIFIED CARS** have been properly reconditioned, and carry a 30-day guarantee for replacement of defective parts and free service on adjustments.
- 3 Every purchaser of a used car may drive it for five days, and then, if not satisfied for any reason, turn it back and apply the money paid as a credit on the purchase of any other car in stock—new or used. (It is assumed that the car has not been damaged in the meantime.)



this
famous
PLEDGE
removes
all risk

in buying a used car!

At last, a real guide, to help you save money in buying a used car—and yours for the asking! "How to Judge a Used Car" has been written out of the experience of men who buy thousands of used cars for resale—in 32 interesting pages and 19 pictures these experts show you step by step how to pick a good used car at lower cost! In a few months' time this booklet has guided 137,000 motorists in saving money in buying motor cars. Send the coupon now for your free copy.

This valuable free book explains in a simple, graphic way how to judge a used car's actual

condition, how to learn the year model, how to set a fair price on a car offered you by a friend, what speedometer figures show, how to avoid "orphans," what code prices mean—why you get five days' driving trial on a used car backed by the famous Studebaker Pledge. Much of this trade information has never before been made public at any price—now the coupon below will bring all of this expert counsel to you without cost.

Before you buy or trade a used car it will pay you to read this free book, "How to Judge a Used Car,"—use the coupon below now!

Mail This Coupon Today!

THE STUDEBAKER CORPORATION OF AMERICA
Dept. I 56, South Bend, Ind.

Please send me my copy of your valuable free booklet, "How to Judge a Used Car".

Name

Street

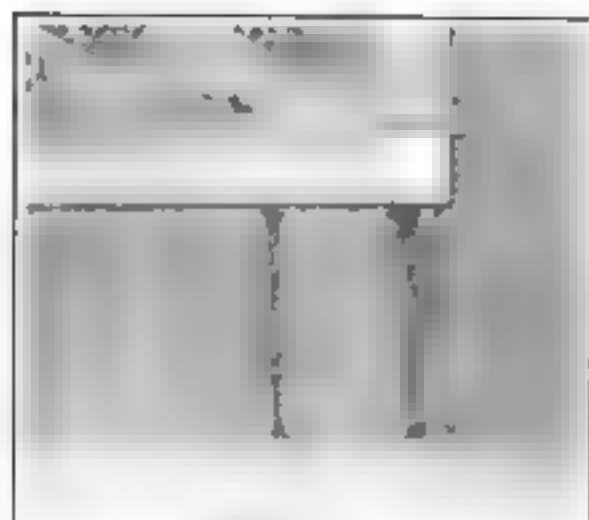
City

State

STUDEBAKER

The Great Independent

Keep Your House Looking New



Urges Everett Eames, Who Explains How to Combat Many Common Defects—Leaks under Windows and Cracks



IT IS easier to build a new house than to keep it looking new. Time and the elements soon produce a subtle change, which advertises its increasing age only too plainly.

Fire excepted, water in the form of rain or melted snow or ice is the most relentless destroying agent. On the outside of the house it streaks the paint and rusts the blind hangers, catches, and other iron hardware and even the flashings, if they are tin. Sometimes the dampness discolors clapboard nails under their coat of paint. It creeps into the house in unexpected ways and soils the plaster and wall paper; it may even warp the flooring.

Next to water, changes in temperature play a large part in aging the appearance of a house, for they produce a continual slow movement of the timbers and all other building materials. Natural shrinkage, too, aids in cracking the plaster, drawing the floor boards away from the baseboards, and causing doors to stick. Constant vigilance on the part of the home owner is necessary to prevent such damage, if possible, and to repair it when it occurs.

It is not, however, the purpose of this article to deal with the obvious requirements—periodical painting, papering,

waxing floors, and the like—but rather to point out a few of the obscure and often neglected details.

One of the most difficult places to make water tight is the joint between the chimney and the roof, particularly at the angles formed by the cricket (Fig. 4), which is the small snow and water deflector behind the chimney. Many build-



Fig. 3. How a molder's stick is used to smooth and round out patching plaster in a corner

ing ordinances insist that the chimney must be at least one inch from all "wood or other combustible substances," and this necessitates bridging with metal the gap where it passes through the roof. Copper should be used but if the house has been built by a speculative contractor, painted flashing tin is probably serving this important purpose. The mere bending of the tin cracks the paint, with the result that rust immediately starts to form. As soon as it is observed, apply paint having a red oxide of iron or a red lead base. Indeed, it is advisable to paint any other exposed tin flashing in roof valleys or around dormer windows in the fall whether it seems to need it or not.

MANY owners of new homes, after the first heavy rain accompanied by a strong wind, are surprised to find streaks of water running down the wall paper below the window sill (Fig. 1). The exact point of entrance is often hard to locate, but a glance at Fig. 2 will show one inlet to lie between the outer window sill and the inner sill, or window stool. This is because the underside of the inner sill was

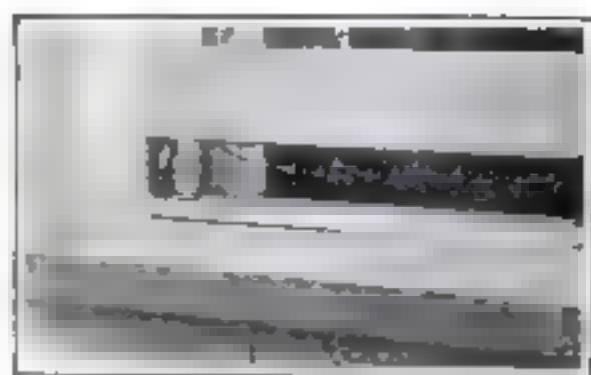


Fig. 2 (at left) Water often leaks in and leaves unsightly discolorations on the walls of a room. Fig. 2 (above) The cause is likely to be a crack between the window sill and the inside stool, which is a molded wood strip resting on the sill.

not painted, and the wood warped or curled upward. A passage from $\frac{1}{8}$ to $\frac{1}{4}$ in. wide is frequently found between the two sills, and through this the water is driven after passing under the lower sash. The remedy is a heavy coat of white lead followed by two coats of paint. Before painting, some of the unthinned lead should be forced into the opening with a knife to serve as a super-patty.

The cracking of plaster on the walls and ceiling is usually the first evidence that the timbers and siding are drying out and are in motion. Unless metal lath has been used, the worst cracks occur in the corners of the room or around the window and door openings. No other disfigurement produces such an appearance of dilapidation as cracked plaster, and artists seldom picture a home of poverty without including a patch of broken plaster. Usually these cracks are not over $\frac{1}{4}$ in. wide and can be obliterated easily. The best way is to cut them out, that is, first make them wider with a tool made from an old file, and then fill them with hard patching plaster, which is obtainable at any hardware or paint store. The smoothing is most easily done with a molder's stick, although a mason's small trowel can be made to serve. The corners can be rounded with the point of the stick as shown in Fig. 3, in fact, it is a good idea to make over all (Continued on page 105)

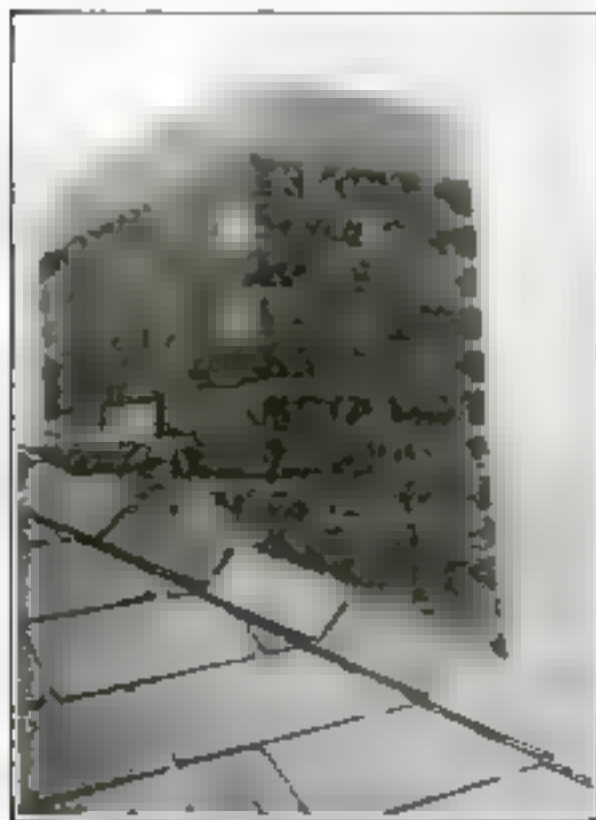


Fig. 4. Any tin flashing around the chimney or elsewhere should be kept well painted.

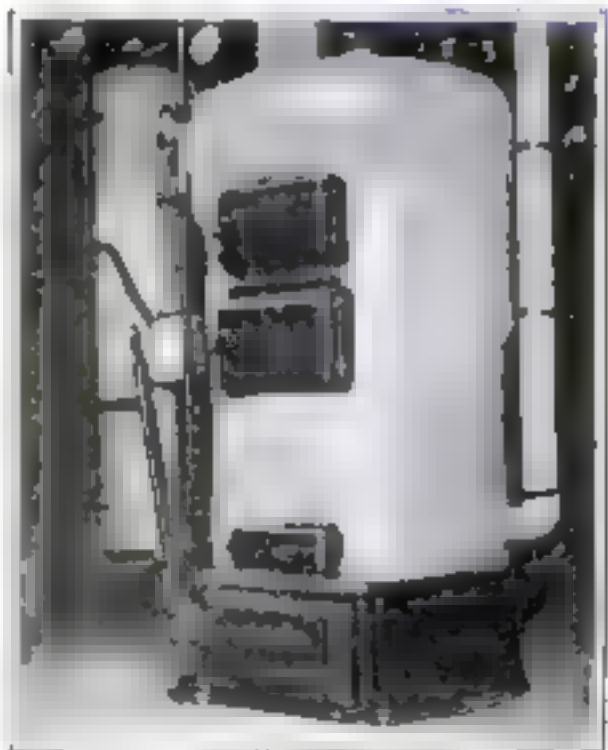


Fig. 5. What Mr. Eames calls the "heart of the house"—the furnace—requires care.

Keep Your House Looking New

REPAIRING CORNERS

corners in this way on account of the greater ease in cleaning them. Hospitals are always plastered with well rounded corners.

Cracks in papered walls cannot, of course, be filled in until the time comes to repaper, but the damage may be concealed by pasting a strip of wall paper 2 in. wide the full length of the crack.

One other noticeable effect of shrinkage is the gap which appears between the baseboards and the flooring, even when $\frac{1}{4}$ -in. quarter-round molding has been used in the angle. The only solution is to remove the small molding in the entire room and substitute $\frac{1}{2}$ - or even 1-in. quarter-round, depending upon the width of the opening to be concealed. The molding should be finished to match the baseboard before being nailed in place. In order to do a good job, the amateur mechanic should use a hand drill to make holes for the brads so as to avoid splitting the molding.

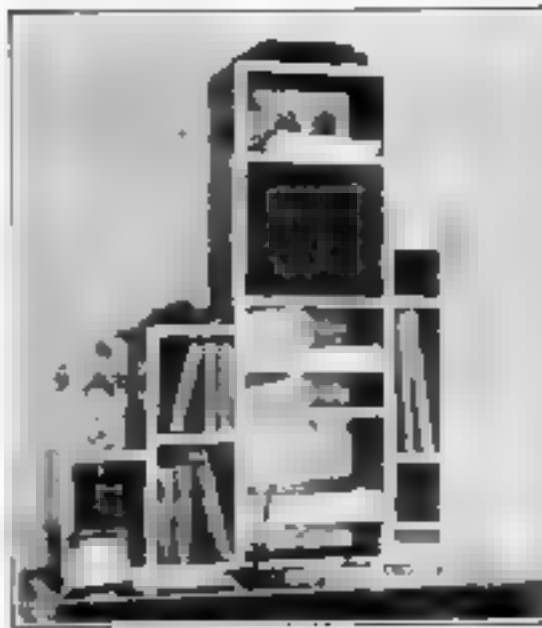
THE heart of the house is in the cellar—the furnace. This important piece of apparatus is seldom properly cared for. Of course, until that millennium comes when all houses are equipped with gas- or oil-fired furnaces, a neat appearing basement will be hard to maintain, but the heater itself should be kept in as nearly perfect condition as possible. If the asbestos covering has become cracked and discolored, it may easily be repaired with asbestos cement. This material, which can be obtained at any hardware or plumbing supply store, requires only the addition of water before being used.

After the cracks and holes have been filled up, the former white appearance of the boiler may be restored with a coat of prepared white water paint or calumine. Three pounds mixed with boiling water will be found sufficient to refinish the largest heater.

For restoring the discolored or rusted iron parts, a coat of high grade black brushing lacquer makes a lasting finish; it not only retards further rusting, but can be washed free of ashes and dirt without damage.

When the heating system was installed, the asbestos covering on the steam pipes was carefully joined, wrapped with muslin, and sealed with asbestos cement. An inspection of these joints after a year or two may show openings at many of the joints. To repair these, the asbestos cement is resorted to and the joint wrapped with brass binders as shown in Fig. 5. These bands can be obtained from a plumber. They are in reality more decorative than useful, but give the new and finished appearance that every home owner should strive to maintain, even in the cellar.

Old range boilers, which can be bought at almost any junk yard, make a good culvert for use under a driveway. After the ends have been cut off, the tanks are placed end to end. —W. W. S.



SET BACK BOOK SHELVES
See LePage's Book, page 9



PLYWOOD BUILD IN CELLAR—EASY
See LePage's Book, page 9

12 NEW Job Plans, Too!

There is, of course, a limit to what we can give in LePage's New Third Home Work Shop for only a dime. But we realize many men want additional projects. Hence our 12 new Job Plans. These also were made by Mr. Kleinknecht. They are projects that require more elaborate presentation than we can give in our book. Each Job Plan presents one project on a single large sheet of paper. Each is well worth its price in time. Look over these projects and order them you want by number (see coupon), enclosing 10 cents for each.

- 16 Sheraton Writing Table
- 17 Sheraton Desk Chair
- 18 Colonial Hanging Book Shelves
- 19 Smoking and Reading Cabinet
- 20 Colonial Mirror
- 21 Tea Wagon
- 22 Telephone Cabinet
- 23 Steel for Telephone Cabinet
- 24 Manual Training Work Bench
- 25 Home Worker's Tool Cabinet
- 26 Spanish Gallery
- 27 Vanity Table

LE PAGE'S GLUE

Handiest Tool in Your Work Shop



CHESS AND CHECKERS TABLE
See LePage's Book, page 13

LE PAGE'S NEW BOOK

will show you how to make 20 attractive pieces of furniture

Yes, a New Book, just printed, the third in the series of LePage's Home Work Shop Books. New and better designs. Made by an expert. Complete, easy-to-follow directions for making 20 attractive pieces of household furniture. Any man handy with tools can easily make these handsome, useful articles right at home.

Good. You can make them in a fraction of that. And yet be the owner of truly fine furniture.

Designed by Expert

All the designs, dimension drawings, actual pieces and photographs were made by William A. Kleinknecht, Instructor in Woodworking, Central Commercial and Marine Training High School, Newark, New Jersey. Also the designer of the first two LePage's Books. Each project and the direction for making it are perfectly practical.

Big Improvement

The first LePage's Home Work Shop Book, two years ago, sold 30,000 copies. Last year the second book sold 55,000 copies. That's popularity for you. An enormous quantity for books of this kind. Now the third new book is better yet. Of its 20 complete projects, 17 are entirely new and never offered before.

In addition to the three pieces shown above, the book contains the following: Cafe Chair, a Treasure Chest, a Nest of Tables, Old Salem Shaker Cupboard, Lady Wash-basin, a new cabinet, Modern Desk, Table, Folding Screen and Free Screen, Smoking Table, Card Table, Chair, China or Book Cabinet, Book Table and Magazine Stand, Magazine Cabinet, Lamps, a new Book Stand, French Stand and Folding Sewing Machine. Where else could you get complete directions for making all these for only 10 cents?

Each project is presented in three parts—a photographic illustration of the finished project, a complete dimension drawing of its parts, and simple, easy-to-follow, step-by-step directions.

This year the designs are divided into three groups. One group is based on famous old designs. Another group follows the furniture in popular demand for American homes of today. The third group is known as modernistic furniture, showing the influence of the modern skyscraper set-back architecture of New York City. To buy all three pieces would cost about

Send 10 cents for this
NEW LePage's Home Work Shop Book

Simply use the coupon below, sending it to us with 10 cents in coin or stamps and we will at once send you a copy of LePage's New Third Home Work Shop Book, postage paid. Address: LePage's Craft League, 608 Essex Ave., Gloucester, Mass. Tear out coupon, so you won't forget it.



MAIL THIS COUPON

LePage's Craft League,

608 Essex Ave., Gloucester, Mass.

Gentlemen: Enclosed please find 10 cents, coin or stamps, in payment for LePage's New Third Home Work Shop Book. Please send a copy of this book to:

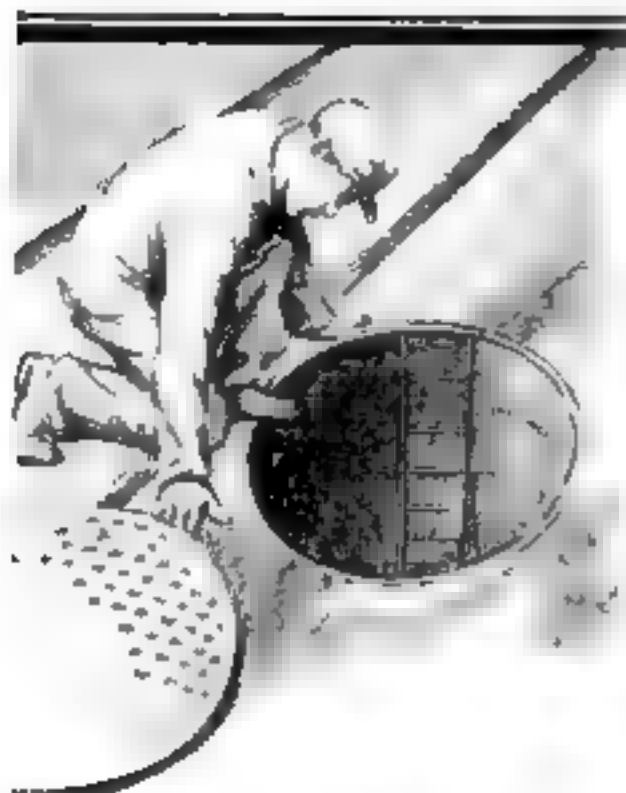
Name _____

Street _____

City _____

State _____

Please also send the following Job Plans: _____
Designs by number, how you want. See coupons at left. For each of which I enclose an additional 10 cents.



Make It Fast Use A TRIMO

Pipe work is minutes faster with a TRIMO Pipe Wrench because of TRIMO quick work features.

The adjustment, once made, stays put. The nut guards keep the adjusting nut from accidental rotation.



Replaceable insert jaws, and rounded lock-proof threads are found on every genuine TRIMO Pipe Wrench.

TRIMONT MFG.
CO., INC.
Roxbury (Boston),
Mass.

When You Want a
Pipe Wrench
Buy a
TRIMO

How to Modernize Old Furniture with Paint

By BERTON ELLIOT

IN A great many houses today there is at least one dresser finished in golden oak, which was once universally popular but is now entirely out of style. Perhaps no more profitable opportunity exists for improving home furnishings than by refinishing one of these old-fashioned dressers, together with a couple of chairs and whatever bed is in the room, into a modern bedroom suite. This may be easily done with pleasing colors of lacquer or enamel and the judicious use of art transfers or stencil designs. The cost is slight compared with the transformation wrought or the price of a new suite of furniture.

Often there is an ivory bedstead in the house that can be made the nucleus of an ivory set, or a bedstead in some other color you would like to match in refinishing the dresser and chairs. If some entirely different color scheme is desired, the bedstead may be refinished along with the other pieces at no great cost.

The decoration of painted furniture depends largely upon the design of the piece. The illustrations show several typical methods, which will enable one to work out an appropriate effect. In choosing a color scheme, consider the woodwork and wall decorations of the room, as well as the color preferences of dad, mother, sister or brother, or whoever is going to occupy the room. Ivory trimmed with apricot is an especially pleasing combination. Turquoise blue, jade green, Italian blue, rose and tan are also good trim colors; in fact, almost any color may be used as a trim with ivory. Lettuce green body color, trimmed with cream or gold, is a pleasing and restful color scheme.

Two-tone effects are especially good in greens or browns.

Chinese red trimmed with black, turquoise blue trimmed with ivory, Indian yellow trimmed with black, forest green trimmed with twilight blue, and black trimmed with orange are saucy combinations that will de-



Fig. 2 Striped effects, either painted or sprayed on, are sometimes used with very good results.

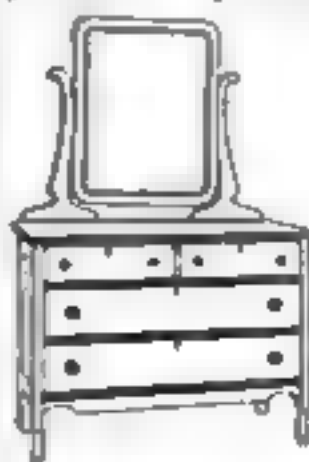


Fig. 1 A simple form—the trim color follows the top molding and the strips between the drawers.

"MOCAR" Model
Airplanes
That Fly

Set No. 1
Only \$1.50
Complete

BOYS at last here is a real aluminum model airplane that really flies. Add it as a small prize.

The "Mocar" airplane—Set No. 1—is a type of the famous four of its kind. With spread 38 in. Length 12 in. Power (1 motor, 200 cc. engine) rubber band drive. Weight complete only about 1 lb.

There is a practical, simple, real model plane that gives you a whole lot of fun for the moderate cost. It is a real flying machine with a sturdy plane that will stand a lot of abuse. The motor is mounted on a rubber band drive. It is a real flying machine and will last for years. It is a real flying machine and will last for years. It is a real flying machine and will last for years.

Great fun. Start here to make and fly airplanes. Order now. Teachers, fathers and schools write for set prices.

The illustrations below show an excellent example of a model airplane. The illustrations show an excellent example of a model airplane. The illustrations show an excellent example of a model airplane.



The Mount Carmel Mfg. Co.
Dept. B. Mount Carmel, Conn.

The Old Reliable Credit Jewelry

LOFTIS BROS. & CO. INC.

DIAMONDS

GENUINE DIAMONDS GUARANTEED AT IMPORTERS' PRICES

Send for FREE Catalog

Over 2000 Diamonds in Diamond and Jewelry. Watches, Clocks, and other fine jewelry. We have a large stock of diamonds and jewelry. We have a large stock of diamonds and jewelry. We have a large stock of diamonds and jewelry.

Rectangular Wrist Watch
No. 10-12 a white gold. \$14.95
An exceptional bargain. \$14.95 a watch.

Wedding Rings
No. 10-12 a white gold. \$14.95
An exceptional bargain. \$14.95 a watch.

Satisfaction Guaranteed or Money Back

FREE CATALOG

Just off the press. Showing Hunting Shoes, Dark Hunting Boots, Leather, and more. Inner soles, Durable Bags, etc.

L. L. BEAN
185 Main St.
Freeport, Maine

A SHIP MODEL FOR \$4.25

Build an exact replica of the historic Santa Maria, the Mayflower or the La Plata with your own hands. We will furnish the parts complete for only \$4.25 plus a few cents for postage. No tools needed except a small hammer. Parts for the construction of the ship model may be had for \$6.95. Write for our illustrated catalog.

MINIATURE SHIP MODELS
Post. O. 10, 2510-24 Barre St., Salem, Pa.

A definite program for getting ahead financially will be found on page four of this issue.

Modernizing Old Furniture

(Continued from page 186)

Light the heart of the most ardent "flapper."

Powder blue trimmed with ivory and French gray trimmed with white are very dainty combinations. Italian blue trimmed with gold is extremely rich.

With the wide range of colors in which lacquers and enamels may be bought, one will have no trouble in obtaining a harmonizing color scheme; and by tinting



Fig. 5. In some instances it is desirable to use the trim color only on certain portions of the molding.

or intermixing standard colors, one may produce individual effects.

The simplest form of decoration, but an always pleasing one, is where the piece depends for its decorative effect upon a trim color following the molding around the dresser top and between the drawers, as in Fig. 1.

In some cases the design is such that certain lines only of the molding and carvings may be followed with the trim color to bring out a desired effect. Fig. 3 shows a treatment of this kind. The top in this case is a third color.

In Fig. 5 the framework holding the mirror has been cleared away and the mirror hung on the wall above the dresser, a treatment which is distinctly modern. If any screw holes are left in the top of the dresser, they can be filled with a crack-filling preparation, and, when enameled or lacquered over, will not be seen. A panel in the center of each drawer is done in trim color; this is possible with pieces which are designed with raised or sunken panels.

A liberal use of both trim color and art transfers is illustrated in Fig. 4. Trim color may be easily applied by the home decorator, wherever the molding, paneling or framework has a definite edge to follow. Transfer or stencil designs may be placed on all of the drawers, on center drawers only, or on the two bottom drawers only; they may also be placed on the end panels of the dresser, if desired.

Stippled effects, as shown in Fig. 2, are preferred by many for painted bedroom suites. Stippling may be done by pouncing on the stipple color with a stencil brush or by spraying with an ordinary insecticide sprayer, either mouth type or hand spray type, or with one of the special lacquer sprayers now being sold. However, unless one has had experience in stippling, it is generally better to make use of the plain color trim method when doing larger work such as bedroom furniture, and try out the first job of stippling on some (Continued on page 188)

GONE ..all Razor Pull and Discomfort

When Beards are Softened
Small-Bubble Way

Millions
wanted these new
shaving results

A faster, smoother
shave... that's what
this offers you. A
quick, easy way to
get your whiskers
off. Without razor-
pull, sting or smart.
There's a difference
in this shaving cream,
men, that you can
prove by test. See
coupon below.



Here's a shave with a smile... just try this new small-bubble lather—you'll see the difference.

GOOD news is printed
here, for every man

who shaves himself. It's the story of a scientific shaving discovery... a startling new principle in beard-softening.

The results will surprise you... shaving has been made delightfully comfortable. You get a quick, smooth shave... every time.

These are results which a test will clearly prove. Clip the coupon if you

seek an improvement in shaving methods.

Small Bubbles the reason

No other shaving cream is like Colgate's... a shaving cream based on the now proven principle that water, and not soap, is the real beard-softener.

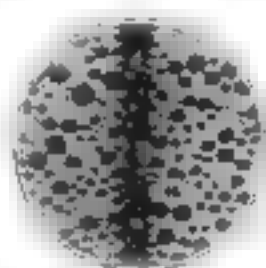
This small-bubble lather is designed to absorb more water.

That's the principle. Now here's what it does for you:

1. The soap in the lather breaks up the oil film that covers each hair... floats it quickly away.

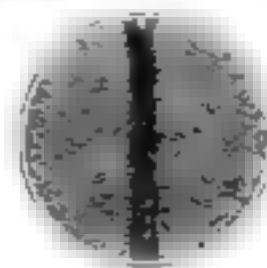
2. Then billions of tiny, moisture-laden bubbles seep down through your beard, crowd around each whisker... soak it soft with water. Instantly your beard gets moist and pliable... limp and lifeless... scientifically softened right at the base.

Thus your whiskers come off clean and smooth. You've never had a shave like this before.



ORDINARY
LATHER

Photomicrograph of lather of an ordinary shaving cream, showing large, dark spots are air—white areas are water. Note how the large bubbles hold air instead of water against the beard.



COLGATE
LATHER

Photomicrograph prepared under identical conditions shows fine, closely knit texture of Colgate's Rapid-Shave Cream lather. Note how the small bubbles hold water instead of air close against the beard.

COLGATE & COMPANY
Dept. 500 L, 591 Fifth Ave. N.Y.
Please send me FREE sample of Colgate's
Rapid Shave Cream. Also sample Colgate's
"After Shave"

FREE OFFER,
MEN!

Name _____
Address _____



Pipe Smoker Lured By Aroma of Fellow Smoker's Tobacco

Many a man has flitted with the bells of a fancy dress ball, only to find, when the time came to unmask, that he had been attracted by his own wife. The same thing can happen in the case of a man's favorite smoking tobacco. In fact, it has. Read the following letter

Boston, Mass.
April 21, 1927

Larus & Bro. Co.
Richmond, Va.

Gentlemen:

This morning I had a smoking adventure worth recording.

Next to me in the smoking car a gentleman was puffing his pipe contentedly. I was not smoking at the moment and the aroma of his tobacco intrigued me exceedingly. For twelve years I had smoked Edgeworth without being tempted by any other brand, but the fragrance emanating from the pipe of the gentleman beside me was so agreeable that I could not resist the temptation to speak of it.

"That is wonderfully fragrant tobacco you have there," I remarked. "Would you mind telling me the name of it?"

"I use Edgeworth," he answered.

We then congratulated each other upon our mutual good taste, and I decided that I would continue to use his brand and name.

Sincerely yours,
S. H.

That's the way it is with Edgeworth Tobacco. Finding it again is like meeting a good old friend.



To those who have never tried Edgeworth, we make this offer:

Let us send you free samples of Edgeworth so that you may put it to the pipe test. If you like the samples, you'll like Edgeworth wherever and whenever you buy it, for it never changes in quality.

Write your name and address

to Larus & Brother Company, 10 & 21st Street, Richmond, Va.

Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Slice and Edgeworth Ready-Rubbed are packed in small, pocket-size packages, in handsome humidor holding a pound, and also in several handy in-between sizes.

Modernizing Old Furniture

(Continued from page 107)



Fig. 4. Trim color and art typeface designs can be used in combination to give decorative effects.

smaller piece such as a magazine rack.

Old brass drawer handles may be removed and replaced with modern wooden or glass knobs, which may be obtained at nearly every hardware store.

It is not necessary to take off the old finish in order to do a first class job of re-finishing with lacquer or enamel, although for the very finest job possible it should be done.

First, wash the piece thoroughly with soap and water and be sure to rinse off with a copious quantity of clear water. When thoroughly dry, go over the entire surface with a cloth saturated with gasoline, benzine or denatured alcohol to cut away any greasy deposits.

Next, sandpaper lightly—just enough to cut the gloss. Where the previous finish is golden oak, it is better not to sand down thoroughly, especially if re-finishing in lacquer. This is because stains are very powerful, and if the protective coatings of varnish and shellac (which seal in the stain) are sanded off, the stain may bleed through and discolor the new finishing coats.

If lacquer is to be used in re-finishing previously stained woodwork, it is a wise precaution to apply a coat of shellac over the entire surface to seal in the stain more thoroughly, for the high-powered lacquer solvents have a tendency to soften the old finishing coats.

This preparatory work completed, the piece may be lacquered or enameled in the regular way—two or three coats of lacquer applied without sandpapering between coats for a lacquered finish, or, for an enamel finish, two coats of flat undercoater followed by one of enamel (or one coat of half undercoater and half enamel, and one coat of full enamel), in which case one should sandpaper lightly between coats.



Fig. 5. Flanging the mirror and using trim color on the panels and top are ultra-modern.

The home worker should discriminate in the grain of the wood he uses. Plain-sawn lumber usually will warp unless fastened securely yet unless otherwise specified, plain-sawn lumber will be sent if a wide board is ordered. Quarter-sawn lumber will not be likely to warp nearly as much. In ordering lumber for a project always consider this point and insist upon quarter-sawn for every wide piece that is not to be strongly fastened.

Dyke's Aircraft Engine Instructor



This book is a complete education or training in the construction, maintenance and repair of the power equipment in use in modern aircraft.

It explains the Wright Whirlwind Engine, the Wasp, the Curtiss, the Fairchild Camco, Engine without crankshaft, connecting rods, valves and Engines which run up-side down, backward, 24-Cylinder, H-pipe and others.

Also miscellaneous equipment such as carburetors, magneto starters, etc. and the engine, etc.

Colored Master Charts and many unusual illustrations make very clear the explanation of a typical engine. You are shown where troubles are likely to develop and what to do to correct or prevent them.

Nearly 400 pp.—7x10 inches—400 illus. Flexible binding.

Price \$5.00—Prepaid.

"Job Way" Auto Wiring Diagrams

A book of 341 uniform diagrams which are practical working drawings of the layout and complete electrical connections of the Starting, Lighting and Ignition Wiring on 112 makes of automobiles. These diagrams are of American passenger cars, trucks and buses from 1920 to 1928.

The book is printed on substantial Kraft paper and is especially arranged for the practice of a mobile repair shop; 8 1/2 x 11 inches flexible fabric-bound.

Price \$5.00—Prepaid.

Diesel & Oil Engineering Handbook

J. ROSBLOOM
Fourth Revised Edition

The importance of this book can best be emphasized when the trend of Diesel engineering for land, marine, locomotive, automotive and other branches of power production is considered. Written in practical language with hundreds of tables and formulas Prof. Rosbloom's book is rated with color and plain views. Complete course of instruction in leading types of Diesel engines.

650 pages—size 8x7 Flexible binding
Price \$5.00—Prepaid.



Book Department
POPULAR SCIENCE MONTHLY
290 Fourth Ave. New York City

[On your radio—tune in on WRVA, Richmond, Va.
—the Edgeworth Station. Wave length 254.1
meters. Frequency 1180 kilocycles]

Making Modernistic Screens

(Continued from page 58)

smooth. They may be finished with black paint, stain, or lacquer.

If wood is used, it is often desirable to allow the grain to show in at least some parts of the design. The method is to stain the wood as desired, fill the grain, if necessary, and apply a coat of thin shellac. This should be rubbed with No. 00 steel wool or very fine sandpaper. Then the parts in silver, black, or other colors may be applied, as in the case of the fourth screen illustrated. As a very last step in the finishing process, a little furniture wax rubbed on the stained wood will give it a soft sheen. In this, as in all the decorating, avoid crude, glossy effects, but let the colors be brilliant.

In two of the screens shown on Blueprint No. 2, a panel is set within the frame and held in place by narrow strips of wood. The panel is either floor or wall board and is covered with parchment, which can be obtained in rolls 42 in. wide. Lines to form the design are either painted on the parchment or made with narrow strips of wood, glued or nailed in place.

Three hinges are better than two in joining one screen unit with another. Where the covering is cloth, it may be necessary only to cut the hinge and covering material away at the points where hinges are to be applied. In the majority of cases, however, the wood itself will have to be cut away. Across the edge where the hinge is to be applied, make a recess equal to the length of the hinge and of a depth equal to its thickness. Screen hinges are made in widths to fit frames $\frac{3}{4}$, 1, and $1\frac{1}{2}$ in. thick.

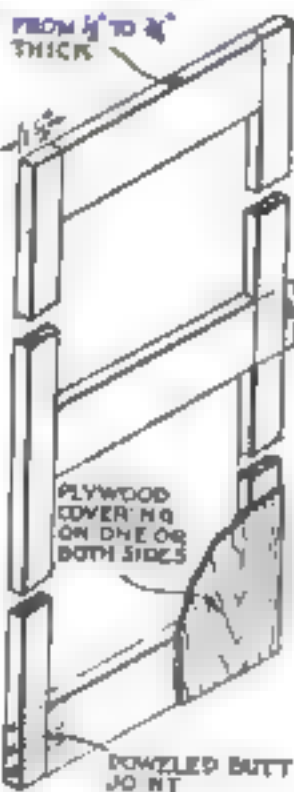
This is the second in a series of articles on a subject that has never been treated heretofore in books or magazines—how to make modernistic furniture at home. The third, which is scheduled for early publication, will describe modernistic lamps.

Giant Model Airplane

(Continued from page 80)

from the nose, to receive the undercarriage.

The undercarriage is made of $\frac{1}{8}$ in. diameter reed (rattan). Draw the outline on a board, then drive nails around it to make a form. Soak the reed in water, place it in the form, and dry it in an oven. The reed will then retain its shape. The top ends of the struts are spaced 5 in. apart and held the axle 11 in. from the fuselage. Bind the top ends of the struts for $\frac{1}{4}$ in. with silk thread and glue. Make a small hole with a brad $\frac{1}{4}$ in. from the end of each strut. The struts are secured to the longerons by forcing a double pointed brad $\frac{1}{4}$ in. long halfway into the longerons and forcing the end of the undercarriage struts onto the other end, first giving the ends of the struts. The joint is completed by passing a piece of 28-gage brass wire through the hole in the strut and then around the longerons. Twist the ends of the wire to fasten them. The front undercarriage struts are located 7 in. from the nose and the rear struts 12 in. from (Continued on page 110)



One of the simplest ways to make a frame.

ATKINS SILVER STEEL SAWS



for Quick, Easy Cutting

In Your Home—In the Shop Out on the Job!

ATKINS Saws and Tools for Your Workshop

No. 53 Hand Saw . . . No.
33 or No. 51 Rip Saw
Coping Saw . . . Com-
pass Saw . . . No. 2 Back
Saw . . . Nest of Saws
Hack Saw Frame
"Silver Steel" Hack
Saw Blades . . . Handy
Saw . . . Scraper Blades
Slim Taper Files . .
Mill B Files . . . Saw Set.

Whenever you cut wood or metal, ATKINS "Silver Steel" Saws will help you do the work faster, easier and better. You'll enjoy making things for the home and doing jobs around the house, with ATKINS Saws. They will save you time, work and money, and outlast two or three "cheap" saws.

At left is a list of ATKINS Saws and Tools needed in every up-to-date home workshop. Ask your Hardware Dealer about them. Write us for the helpful books on Saws, shown below. FREE—just send the coupon.

E. C. ATKINS & CO. Est. 1897

425 So. 11th St., Indianapolis, U. S. A.
Leading Manufacturers of Highest Grade Saws for Every Use
Saw Tools Saw Specialties Planing Tools
Machine Knives Grinding Wheels and Files



Use
This
Coupon

Please send me your Free Books, "SAW SENSE" and "SAWS IN THE HOME."

Name . . .

Address . . .

My Dealer's Name . . .

Giant Model Airplane

(Continued from page 110)

line and meet at the center line of the leading edge, which is $\frac{1}{4}$ by $\frac{1}{4}$ by 15 in. white pine. The remaining ribs are spaced $3\frac{1}{4}$ in. apart and cross the spar at the same angle as the center ribs. The ribs are secured to the bars by glue and seven wraps of silk thread each way.

The leading edge and the trailing edge (the latter $\frac{1}{4}$ by $\frac{1}{4}$ in. white pine) are secured by binding five wraps of thread immediately back of the edges but around the ribs so as to clamp the edging in place. The spar overhangs the end ribs 4 in. The edges overhang the end ribs $\frac{1}{4}$ in. The tip outlines are bamboo $\frac{1}{4}$ by $\frac{1}{4}$ in. The tip is bound to the inner sides of the leading and trailing edges and passed around the end of the spar. It may be necessary to bend the outline pieces slightly. This can be accomplished easily by holding the bamboo over a candle flame and, as it heats, forcing it into the required curve.

The stabilizer is covered on both sides with China silk. Stretch the silk over the frame and brush over the outlines, ribs and edges with dope. The dope penetrates the silk and causes it to stick firmly to the frame. After it dries in place, trim off the margin with a razor blade and apply one coat of nitrate dope. Brush very lightly, otherwise the top and bottom surfaces will stick together. Should this happen, they probably can be pulled apart with a needle before they are entirely dry.

THE main wing is of the double surface type. The spars are $\frac{1}{4}$ by $\frac{1}{4}$ in. by 8 ft. white pine. The wing has a built-in dihedral angle. Mark the center of a spar on one of its $\frac{1}{4}$ -in. faces, 2 in. to one side mark another vertical line. Draw a diagonal line from the top of one of these lines to the bottom of the other—the diagonal of a rectangle $\frac{1}{4}$ by 8 in. Cut along this line, reverse the sides of the cut, and bind the spars together with glue and silk thread to form a splice. Reinforce the splice by gluing and binding with thread on one side a $\frac{1}{4}$ by 4 in. piece of 30-gage aluminum or light tin. The spars are set on edge, that is, the greatest depth is the vertical measurement.

The ribs are bamboo $\frac{1}{4}$ by $\frac{1}{4}$ by 10 in. There are 18 upper and 18 lower ribs. The upper ribs are bent to an even curve by heating them over a candle flame, the highest point of the curve being one third the length of the ribs from the leading edge. The curve is 1 in. high. The lower ribs are bent the same way but should have only a barely perceptible curve.

The center ribs are spaced 2 in. on each side of the center line, and the remaining ribs are spaced at 8-in. intervals, leaving a spar overhang of 4 in. The ribs are secured to the spars by gluing and binding with nine wraps of silk thread each way. The same binding holds both upper and lower ribs. The front spar is located 2 in., and the rear spar 8 in., from the leading edge.

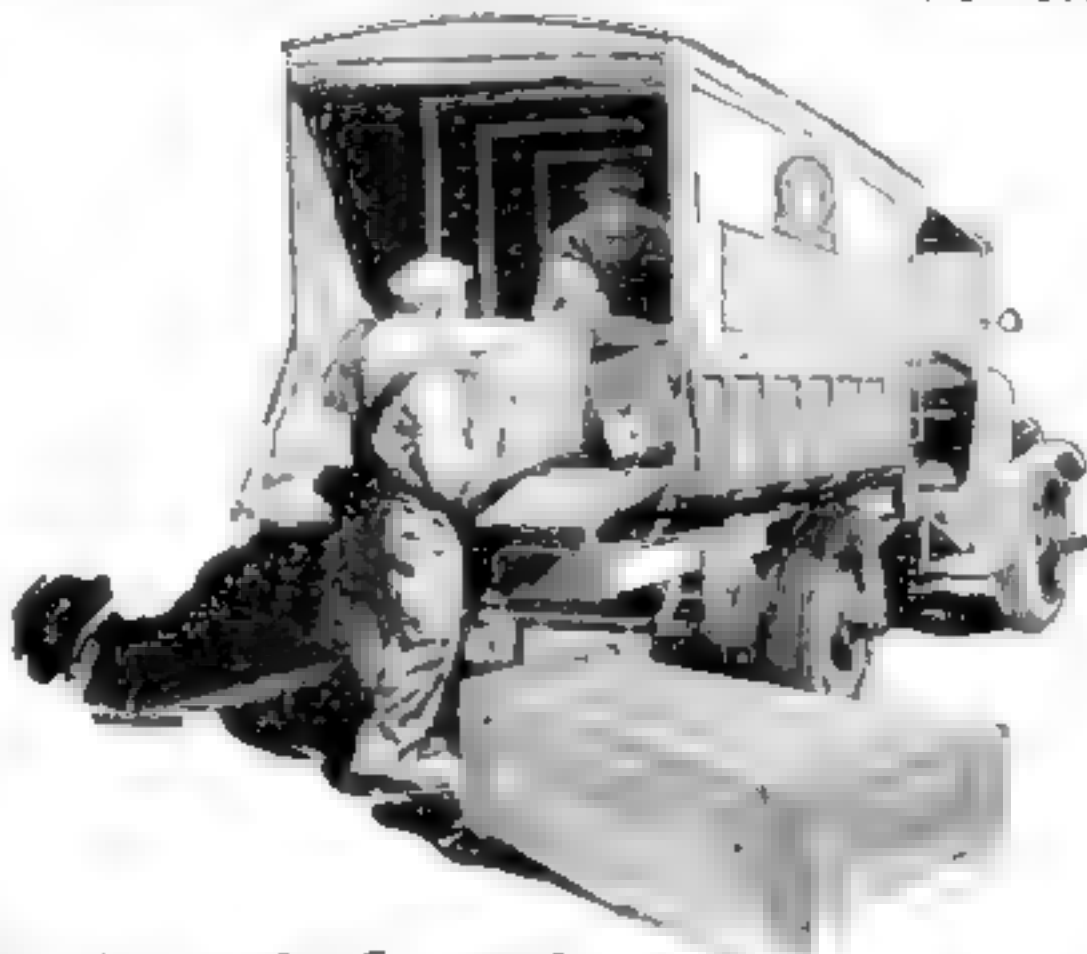
THE leading and trailing edges are of white pine $\frac{1}{4}$ by $\frac{1}{4}$ in. and overhang the end ribs $\frac{1}{4}$ in. The edges are secured by binding and gluing with five wraps of silk thread around the ribs back of the edging, thus clamping the edge in place. The tip outlines are of bamboo $\frac{1}{4}$ by $\frac{1}{4}$ in. They are bound to the inner side of the edges and pass around the spar ends. Should it be necessary they can be bent by heating over a candle flame.

The trailing edge between the two center ribs is cut away. This allows the wing to rest across the fuselage on its leading edge and rear spar thereby giving the wing the necessary angle of incidence as the trailing edge drops below the line of the fuselage.

To keep the pull of the covering from distorting the center ribs, it is necessary to install two rib braces of $\frac{1}{4}$ by $\frac{1}{4}$ in. bamboo, which run from the tips of

(Continued on page 112)

OIL HEAT — AS BENEVOLENT AS SUNSHINE



Don't wait for winter —install oil heating NOW!

If you are planning to install oil heating *some time*, why not do it now, and enjoy its advantages this winter?

What your automobile has meant to you in convenient transportation, your oil heater will mean in convenient heating comfort. Once you have experienced its advantages, you will wonder how you ever got along with any other heating method.

If oil heating did no more than free you from the coal shovel, that alone would make it worth your while; if it did nothing but relieve you of the dust and drudgery of ashes it would pay its own way. But in addition, it gives you wholesome, uniform automatic heat, it gives you an extra room in the basement, it provides a method of refueling at the curb as simply and easily as your car is refueled; and through its sensitive, automatic control it keeps the house at an even temperature not only during zero weather, but during the trying days of spring and autumn when it is very difficult to control a furnace fire.

The oil heating dealer in your community will be glad to advise you. He will inspect your present heating plant, or your plans if you are building, and give you estimates on an efficient and economical oil heating system.

For your guidance, the Oil Heating Institute has published a series of non-technical books, written by authorities on domestic oil heating. The coupon will bring you the book you want. Mail it today—and prepare to enjoy oil heat this fall and winter.

OIL HEATING INSTITUTE

420 Madison Avenue, New York

The Oil Heating Institute is prepared to furnish special information on the heating of churches, theatres, hotels, apartment houses and office buildings, and on the various heat treating processes of industry.



This is the Emblem of the
Oil Heating Institute

It is the symbol of satisfactory public service in oil heating.

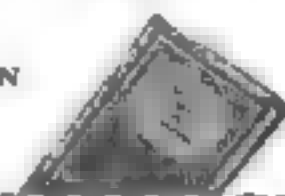
Only the manufacturers who are members of the Oil Heating Institute are permitted to use it.

These manufacturers have earned their membership through the enthusiasm of thousands of home owners whom they have provided with efficient and dependable oil heat.

This emblem protects you, and it will be protected, on your behalf, by the Oil Heating Institute.

Check the book you want

MAIL
THE COUPON
TODAY!



OIL HEATING INSTITUTE
420 MADISON AVE., N. Y. CITY
Please send me, free of charge, the following information on oil heating equipment:
Does it Pay to Install an Oil Heater?
Are Oil Heaters Perfected?
What About the Supply of Oil Fuel?
Making Better Use of the Basement

Name

Address

City

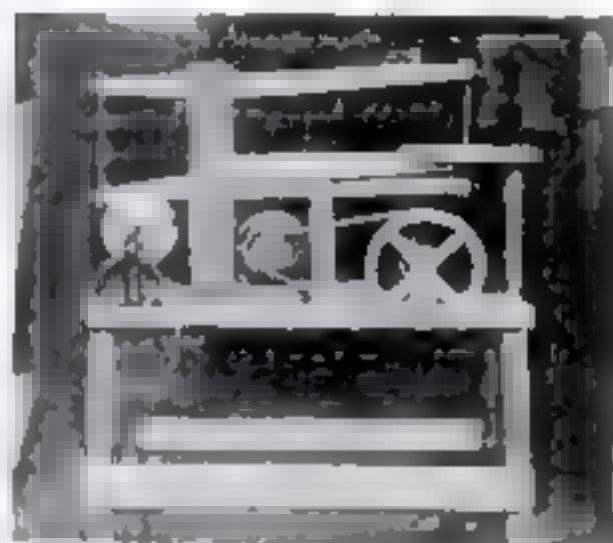
State

P.S.

Sturdy Jig Saw Built at Low Cost by Doctor

WHAT can be done at almost no cost at all by an ingenious amateur mechanic is demonstrated by the accompanying illustration of a jig saw built by Dr. L. St. John Hely, of Richmond, Calif.

Wood from packing cases served to make the framework except the legs, which cost 30 cents, and the base, which is a piece of 2 by 12 in. Douglas fir left over from a building operation. The wheel bearing, crank shaft and motor are



The blade of this homemade jig saw is set so that it never jerks the work around.

from a discarded suction machine of a type used by surgeons for tonsil work.

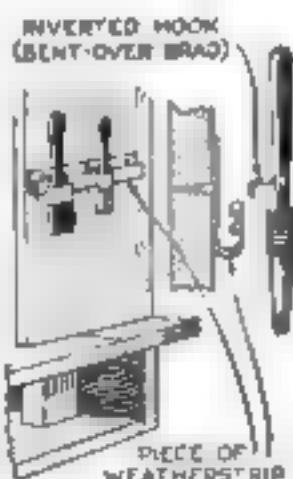
The legs are fastened to the bed by means of $\frac{1}{2}$ -in. machine bolts, the remainder of the frame is fastened with flat-head wood screws. There is a clearance of 18 in. from saw blade to fulcrum.

A regular jig saw blade, $8\frac{1}{2}$ in. long, is used. It is set in the frame in such a way that it advances toward the work on the down stroke and draws away from the work on the up stroke. Thus it does not tend to lift or jerk the work upward upon the up stroke. Dr. Hely had noticed that many jig saws have a tendency to draw the work up, therefore he designed the arms of his own machine to avoid this.

The 1/10-H.P. motor turning at 1,840 revolutions a minute drives the blade at 500 strokes a minute. The stroke is 2 1/4 in., and the machine will cut 3-in. wood.

Neat Rack for Paint Brushes

A GOOD serviceable holder for stain and paint brushes can be fashioned in a few minutes from a piece of metal weatherstrip of the type illustrated. Drill $\frac{1}{8}$ -in. holes not more than 8 in. apart and fasten any desired length of the strip to the bench or wall with $\frac{3}{8}$ -in. No. 10 round-headed screws. Drive a $\frac{3}{8}$ -in. brad into the back of the metal butt and bend the strip to form an inverted U-shape. —J. EDDY



A paint brush rack made of weatherstrip.

of each brush near
end to a right angle
look for engaging the
HARD BOND.



Where the Bell System's profit goes

*An Advertisement of the
American Telephone and Telegraph Company*



THERE is in effect but one profit paid by the Bell Telephone System. This profit is not large, for it is the policy of the Bell System to furnish a constantly improving telephone service at the least cost to the public.

The treasury of the American Telephone and Telegraph Company receives dividends from the stock of the operating companies. It receives a payment from the operating companies for research, engineering and staff work. It receives dividends from the Western Electric Company—makers of supplies for the Bell System—and income from long distance operations.

Only one profit is taken from this money in the American Telephone and Telegraph Company's treasury. That is

the regular dividend to its stockholders—now more than 420,000 in number—which it has never missed paying since its incorporation in 1885.

Money beyond regular dividend requirements and a surplus for financial stability is used to give more and better telephone service to the public. This is fundamental in the policy of the company.

The Bell System accepts its responsibility to provide a nation-wide telephone service as a public trust.



AGENTS
SERIES 1000
VOLUME 1

THE FIFTH ANNUAL CONFERENCE PROCEEDINGS

[illegible]

LITTLE BROTHER CO. 44-70% B4

SHOW YOUR NAME ON TOOLS

WITH THE
ARKOGRAF

[illegible]

JUST OUT! SPORTS No. 1 COMBINATION PEN and PENCIL
AGENT'S SAMPLE 66c SELLERS FOR \$1.35. MAKE JIB DAILY 8 Different Colors

Guaranteed 2 Years
Money Back
If Not
Satisfied

SEES FOR \$1.35.
MAKE JIB DAILY
EASLY

■ Different Colors

1997

100

1992

FREE INFORMATION CARD

H & CO. THE FINE

can stand with
corporate writing 31 YLO point
Letourneau Center, Miss

F. SPORN & CO. 721 Frank St., Letourneau Center, Miami

IF YOU CAN USE AN EXTRA \$20.00 BILL

write for

FREE BOOK

How to make
Home-Automobile
Repairs



Do it with
SMOOTH-ON

YOU can save
\$20.00 in no
time by using

SMOOTH-ON No. 1

to do your own household repairing—and in addition you will have that proud "I-did-it-myself" feeling.

Here is what one enthusiast did with two 35 cent cans:—A \$24 lamp stand loose in base, two big leaks in heating furnace smoke pipe, loose hammer handle, and three loose hooks in tiled bath room wall were all put into good usable condition at an average cost of 10 cts. for each repair—and \$20.00 easily saved over what would have been paid to professional fitters or for new parts.

By using Smooth-On to make dozens of the simple repairs necessary in every home, you can save enough to pay your radio upkeep, buy yourself or your wife a camera, a bull pup or some other pleasure giving article that you would otherwise have to spend the money for.

On the Automobile

Smooth-On No. 1, being unaffected by water, oil, gasoline or heat, is also excellent for auto, mobile repairs. Try it for stopping radiator-tank, pipe line and hose connection leaks from the outside, keeping exhaust line connections tight to prevent the escape of obnoxious burnt gases, repairing cracked water jackets and crank, gear and differential cases, keeping grease cups, lubricator connections, nuts and hub caps from loosening and falling off, tightening loose hinges, tube racks, etc.

The FREE Smooth-On Repair Book

will show you how an astonishing number of home and automobile repairs are as easy for you to make as for somebody else.

Mail the coupon for a free copy and get Smooth-On No. 1 in 7-oz. or 2 or 5-lb. cans from any hardware store.



Smooth-On Mfg. Co.

Dept. 58, 574 Communipaw Ave.
JERSEY CITY, N. J.

Do it with SMOOTH-ON

SMOOTH-ON MFG. CO., Dept. 58.

574 Communipaw Ave., Jersey City, N. J.

Please send the free Smooth-On Repair Book.

Name

Address

8-38

How to Whittle a Ship Model

(Continued from page 60)

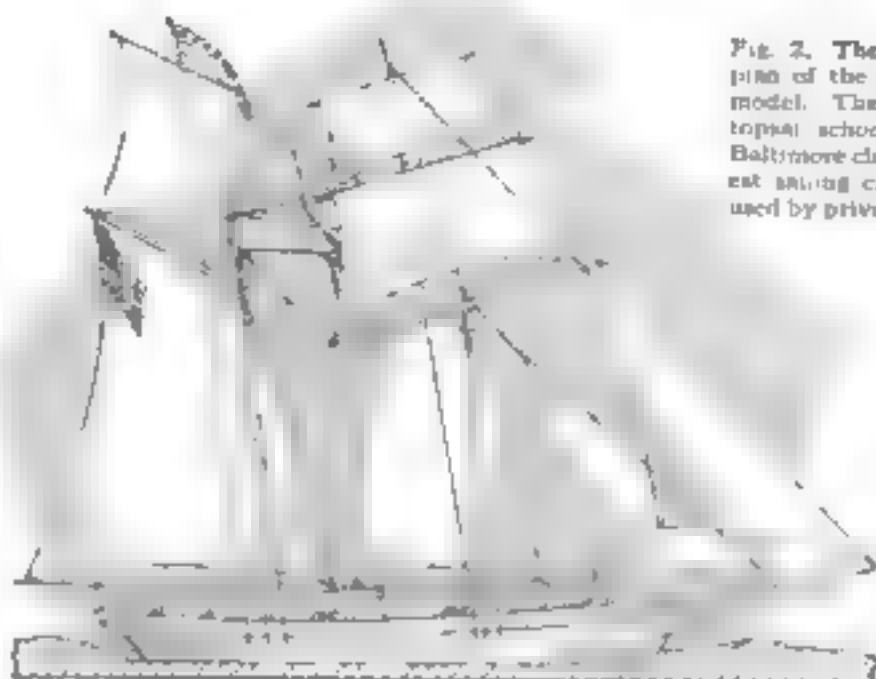


Fig. 2. The sail and rigging plan of the picturesque little model. The rig is that of a topsail schooner. In 1812 the Baltimore clipper was the fastest sailing craft afloat, hence used by privateers and pirates.

Bore $\frac{1}{4}$ -inch holes for the mast at the positions indicated, noting that they rake a long way aft. Make a $\frac{3}{32}$ -inch hole in the stem for the bowsprit. Make the masts, booms, lower yard, and bowsprit, tapering them neatly. The lower and top-masts may be in one piece, with holes through the apparent joints for the lower rigging and stays.

The sails (Figs. 1 and 8) are much easier to make than they appear to be. Even-grained soft wood is required (unless you prefer to use linen). For the upper topsail (the highest athwart sail) cut a piece $\frac{1}{4}$ inch thick to the outline given, including the yardarm. Along the top scribe two lines to indicate the thickness of the yardarm; along the bottom and sides mark lines to represent the edges of the sail, the bulges, of course, being toward the front. Now whittle the wood on the front until you get nicely rounded curves from the front edge of the yard to the clews (bottom corners). Turn the wood over and whittle away the inside until it is paper-thin at the edges, with just a shade more body in the middle and at the clews. Cut up to the underside of the yard and shape the yard until it is round and of the right size. It is as if the sail were fastened to the top of the yard and hanging in front of it.

THE same method applies to the cutting of all the sails. The edge lines of each are given full size on Blueprint No. 92. The jibs are paper thin at all three edges.

The upper spars (gaffs)

are part of the sails in the case of the fore-sail, mainsail, and gaff topsail. The lower spars (booms), however, are separate pieces because the sails touch them only at the two ends.

The least wood left anywhere, the better; but a little in the belly of the sails will not be apparent, and makes the whole much easier to carve. The forward edges of the fore- and mainsails may have a slight flatness, to allow them to be glued to the masts. (Continued on page 118.)

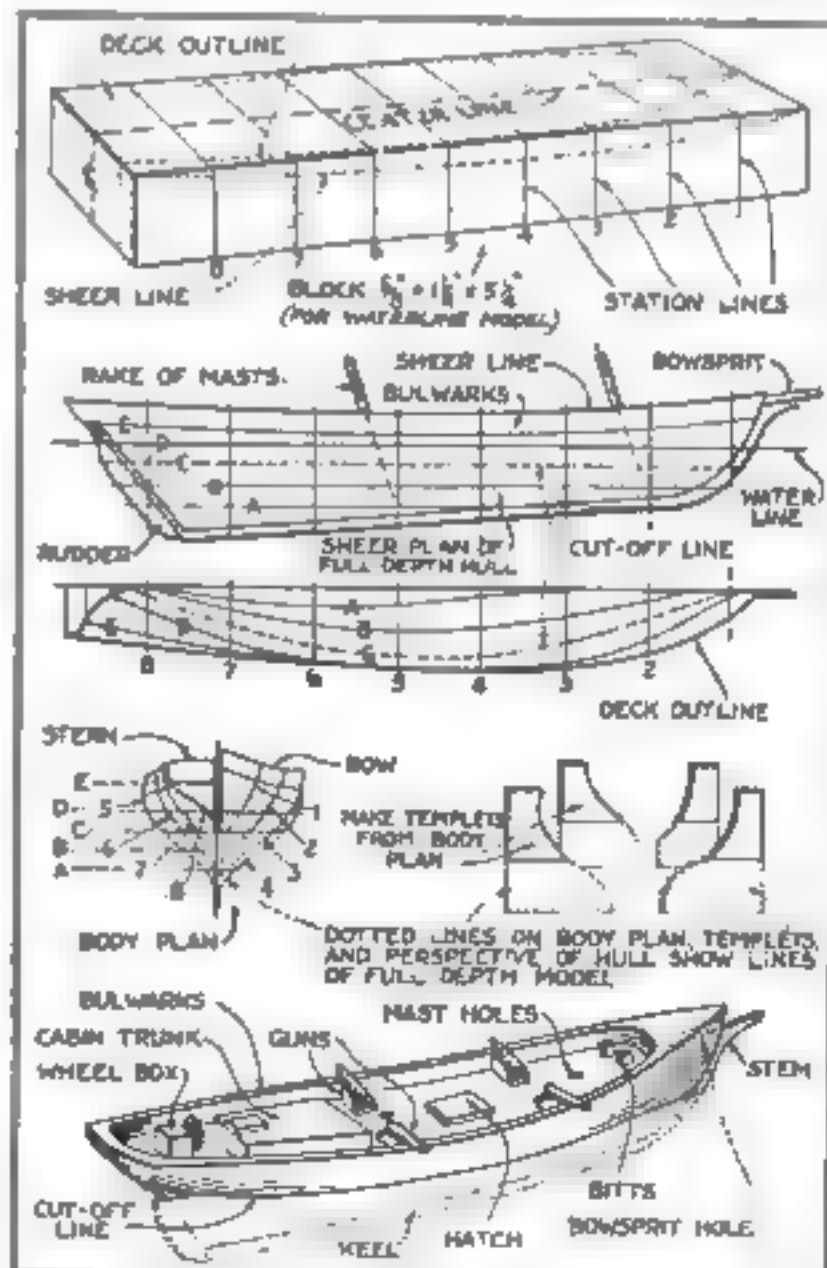
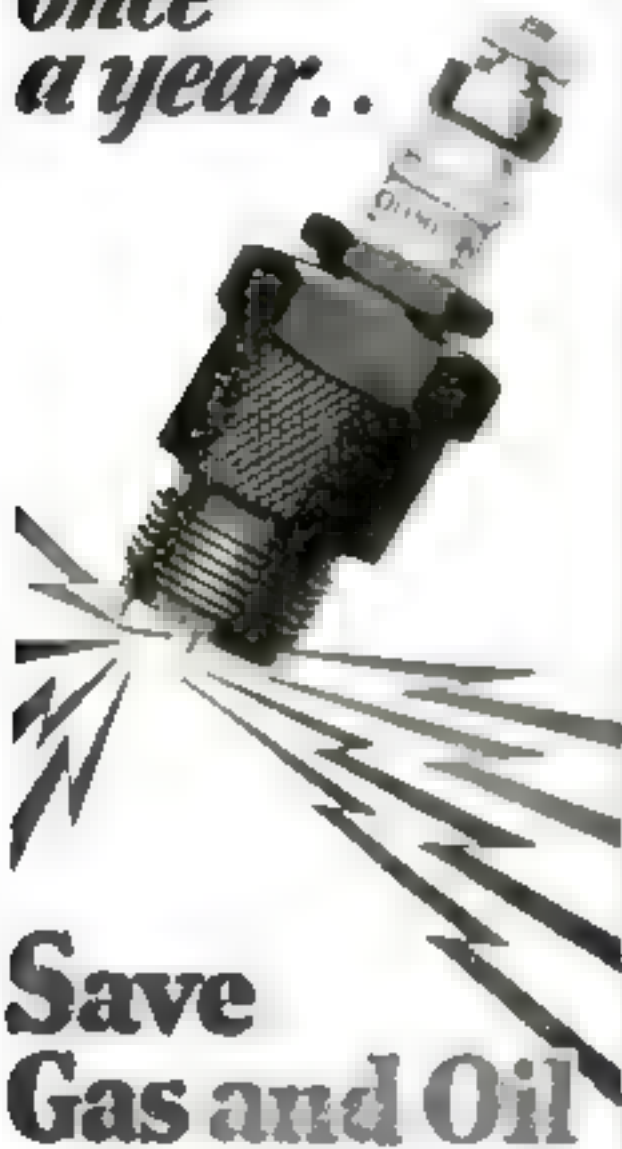


Fig. 3. How the hull block is laid out: the sheer plan, half breadth plan, and body plan hull templates; the completed hull.

New Champion Spark Plugs once a year...



Save Gas and Oil

TO install new Champion Spark Plugs once a year actually costs you nothing, as they quickly save their price in gas and oil.

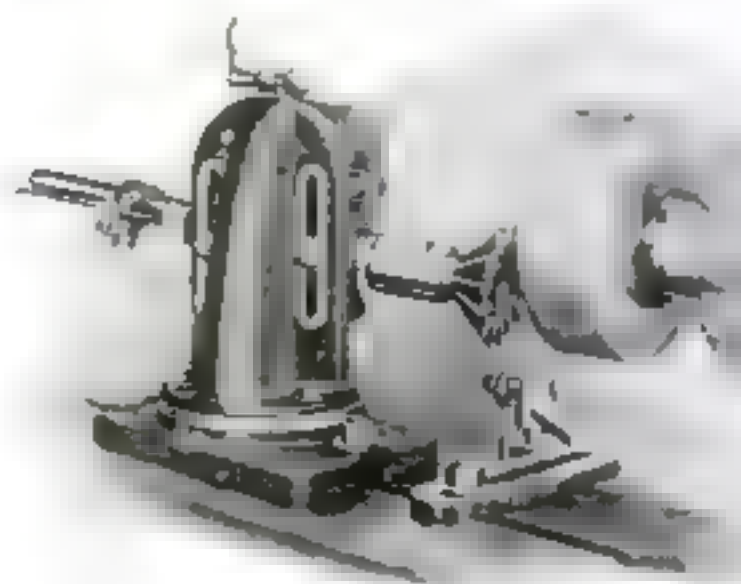
After 10,000 miles of service, spark plugs deteriorate, no matter how well made they are. The spark is weakened. Combustion is only partially complete. Unburned gas is wasted through the exhaust. Power is lost. Engine performance is seriously impaired.

Even though Champions last longer than other plugs, a new set assures more complete burning of the gas. Engine efficiency is restored. Power, speed and all-around performance are improved to an amazing degree.

The saving in gas and oil, and the freedom from repair expense, are so immediately obvious that the regular change of spark plugs at least once a year becomes economically sound and eminently practical.

CHAMPION SPARK PLUG CO.
TOLEDO, OHIO

CHAMPION



An angular cutter set up for sharpening. The use of a cup wheel has the advantage in many cases of making it easier to grind the clearance at the end where the teeth are very close together.

Sharpening Milling Cutters

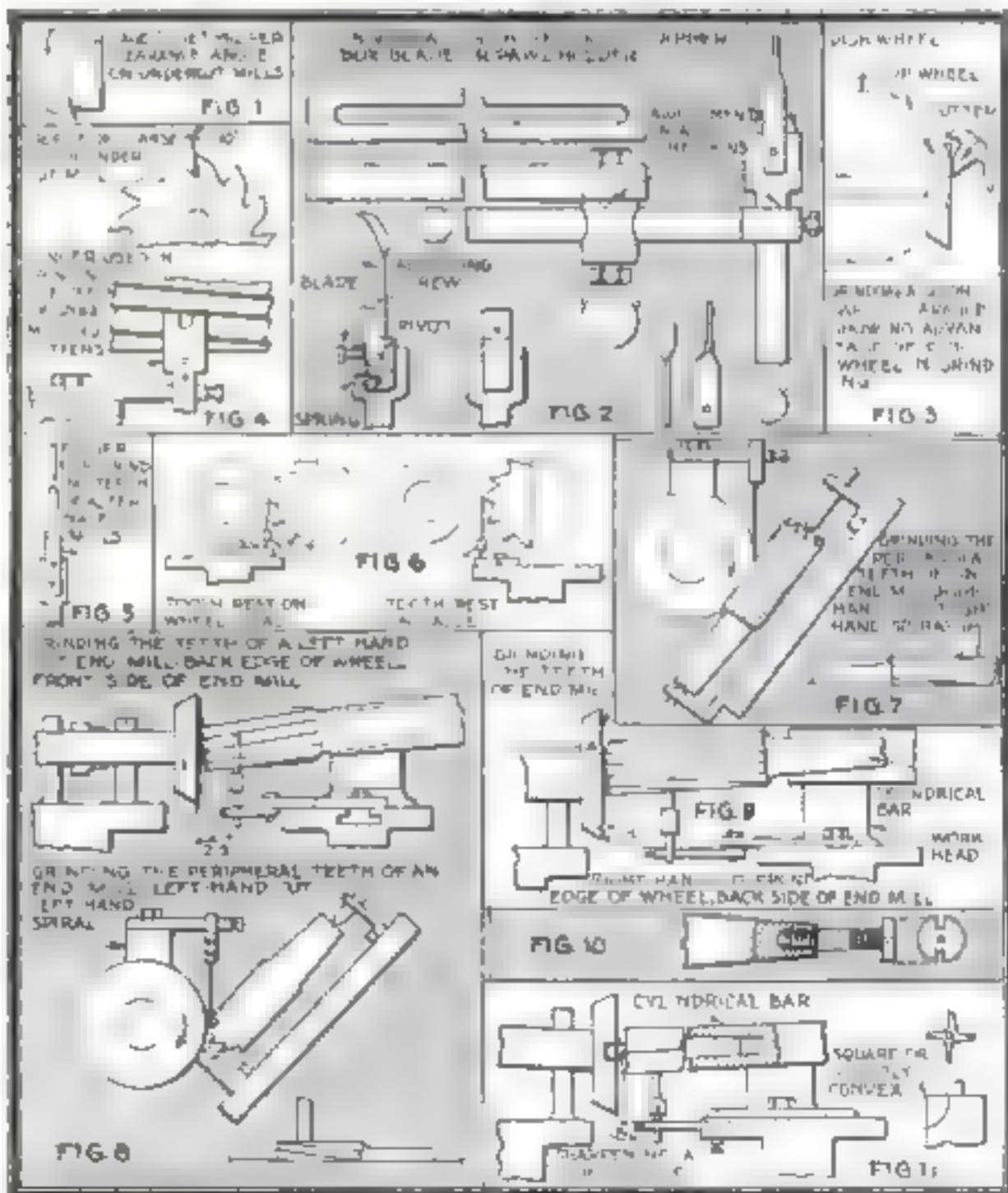
(Continued from page 84)

the cutter and the steepness of the angle must be considered. In many cases the cup wheel is to be preferred.

The side teeth of angle angular cutters are ground the same as side mills. For the angular side both cutter and work head have to be reversed, whether the cutter is single or double, right- or left-hand. Some special angular cutters have spiral-cut teeth. To test the angle

when grinding these, the quickest method is to use a template. A piece of hardwood 1 in. thick is clamped in the milling machine vise and squared up on one side with a side mill. Then a cut is taken with an angular cutter.

Reamers are ground cylindrically to size and then backed off with a cup wheel. The cutting clearance, also the secondary clearance, should be the same as when the reamer was new.



Diagrams to illustrate interesting points in Mr. Chamberland's discussion. In the tooth rest (Fig. 2) the slotted member is $\frac{1}{4}$ by 1 by 2 in., the round arm is $\frac{1}{4}$ in. in diameter and 6 in. long.

By *DOING* a Little Amateur Bricklaying, *YOU CAN*

Build an Indoor Incinerator

It Reduces the Cellar Fire Hazard and Saves Much Trouble in Burning Paper, Sweepings, and Trash

By JAMES GODFREY

DISPOSING of paper sweepings, and other combustible rubbish which constantly accumulates in every cellar is an ever less task. Worse still, their storage while awaiting disposal creates a serious fire hazard. To burn the rubbish in the furnace, as it does the paper, ruins the fire in winter, and heats the house in summer. If the house is equipped with a furnace, the accumulated trash must be burnt out of doors



All the incinerator waste of the household can be burned safely in this type of incinerator.



Mr. James shows how the brick walls are built up after the flat grate bars are in place.

where it may annoy the neighbors and possibly endanger surrounding property from flying sparks.

A simple solution of the problem is to build a brick incinerator in the cellar and keep the trash fires indoors where they belong. It is not necessary to be a mason to accomplish the feat; anyone can construct an incinerator like that illustrated. The principal materials required are a bag of Portland cement, 15 lbs. of unslaked lime, about 150 common brick, a clean-out door, and a few other metal parts to be mentioned later.

A cement base is first laid, followed by three courses of brick. On top of the third course a grate is formed of metal strips; then the walls are built to the desired height. The top is then put on and a connection made to the chimney.

The incinerator shown has a capacity of about a barrel and a half of loose papers, but the dimensions may be varied, of course, to suit conditions. If the base

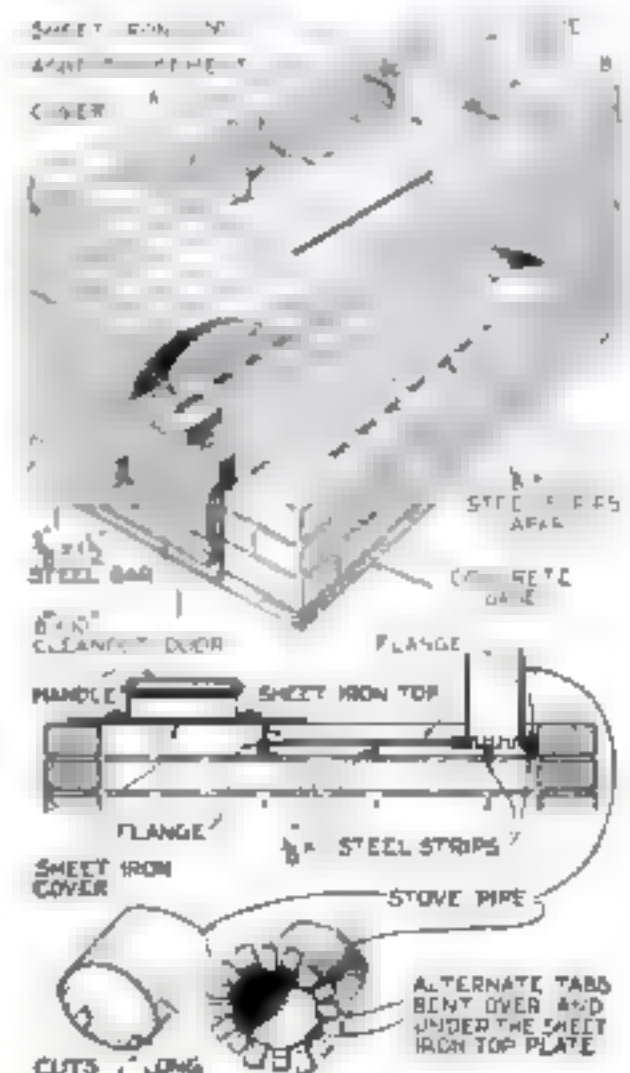
of a fireplace chimney or a large furnace chimney is accessible, it may be used as one wall of the incinerator.

The base should be made of one part of cement to three parts of sand. Its thickness should equal or exceed the overhanging flange of the clean-out door. An 8 by 10 in. door is recommended; it may be obtained at any large hardware store. When the base has set sufficiently place the door in position by stacking bricks in front and in back of it. Next lay up three courses of brick. Break the joints and use a thin layer of mortar. The top of the third course will come about level with the top inner flange of the clean-out door.

A strong, easily handled mortar is made as follows: To one bucket of sand sifted through fly screening add one quarter bucket of slaked lime and one third bucket cement, mixed in the dry state. This amount of lime should give the mortar a clinging quality not possessed by an ordinary cement, sand, and water mixture. To slake the lime place the lumps loosely in a pan or a wooden box and slowly pour on water until the bubbling and steaming ceases. The heat produced should dry out the lime quickly to a powdery state unless too much water has been added. If it remains in a smooth, pasty condition, it requires

more mixing and should not be added to the sand-cement and water until they have been mixed. Be careful not to touch the lime when it is soaking, as it will scald the skin. After soaking water and do not try to mix the mortar in a pan, but use a mixing bucket or the concrete floor of the cellar. About two buckets of mortar should be sufficient for three courses of brick.

The grate should be made up of 1 by 1 in. steel strips laid 1 in. apart and supported down the middle with a 3/4 by 1 1/4 in. steel bar, one end of which rests against the inside edge of the door and the other on the rear brick wall. If the steel strips do not lie flat on the side walls, bend them slightly in the middle so that they will just clear the middle support. They will settle into position later. About 17 lbs. (40 ft.) of 1-in. strips will be required for this, but 20 lbs. should be bought as a few strips are required to support the top.



A broken-away drawing of the incinerator showing the grate, the top, and the cover a longitudinal section through the top, and a detail of the joint between stove pipe and top.

Indoor Incinerator

(Continued from page 114)

Continue the bricklaying until the desired height is reached—a total of from ten to twelve courses. Point up the mortar with a rounded stick after it has set for about an hour. In order to make a true and square job, a carpenter's level should be employed unless the base of a chimney is being used as a starting point, in which case a straightedge will do.

Place steel strips edgewise between the joints of the brick to support the top, which is a piece of heavy galvanized sheet iron with a hole cut out with a cold chisel for the smoke pipe. A short piece of ordinary stovepipe should be attached to the opening thus made. This can be accomplished by using a pair of tin snips to make a number of cuts 1 in. long and approximately $\frac{3}{4}$ in. apart around one end of the pipe. Alternate tabs should be bent outward at right angles and the end of the pipe thus "fringed" thrust through the opening in the galvanized sheet. The tabs which pass through should be bent outward at right angles on the underside and both sets hammered tight so that the pipe is held rigidly.

If the smoke pipe is joined to the heater pipe, an opening for it may be cut with a cold chisel, provided a piece of cordwood or any other heavy object is thrust into the pipe to cut against. It is not necessary to cut an accurate hole, as the joint can be sealed easily enough with asbestos cement. The top from A to B is covered with asbestos cement.

All that remains is to make a cover for the opening into which the rubbish is to be dumped. This is a piece of sheet steel $\frac{3}{4}$ in. thick to which is attached a handle. If a hinged cover is preferred, the steel strip marked C should be drilled for rivets and hinged to the cover before it is set in the mortar.

Shavings Used to Imitate Difficult Inlaid Work

IMITATION inlaid inserts or marquetry ornaments can be made from shavings in a fraction of the time required to cut and apply real inlays.

With a very sharp, finely set plane, prepare a few wide, thin shavings of the wood or woods to be used in the "inlay." Choose woods that will contrast with the surface to be inlaid.

Cut the desired design from the shavings with a pair of sharp scissors and use manicure scissors, if necessary, for any very intricate curves. Apply liquid glue to the spot where the inlay is to be placed on the piece of furniture or other work to be ornamented, and allow it to become tacky. Then press the prepared shavings carefully in place and wash off any surplus glue. With a rolling-pin or any convenient roller, flatten the shavings into the wood as far as possible. In soft wood they will sink flush with the surface.

When the glue is thoroughly dry, the finish may be applied. Preferably this should consist of one coat of thin shellac and several coats of varnish. Each intermediate coat should be rubbed with very fine sandpaper, and the final coat with powdered pumice stone and oil.

With a little practice anyone can obtain admirable results by this method. If it is desired to use some color in the "inlays," a few shavings should be dyed beforehand with wood stains or household dyes.—L. T. G.

Coming and fret blades and still finer jewelers' saws are likely to become rusty when kept in a cellar workshop or in any place where they are exposed to dampness. To make a rust and acid proof case for these blades, obtain a piece of glass tube of suitable size, seal one end over a Bunsen flame, and cork the opening. —G. O. L.

SIMONDS

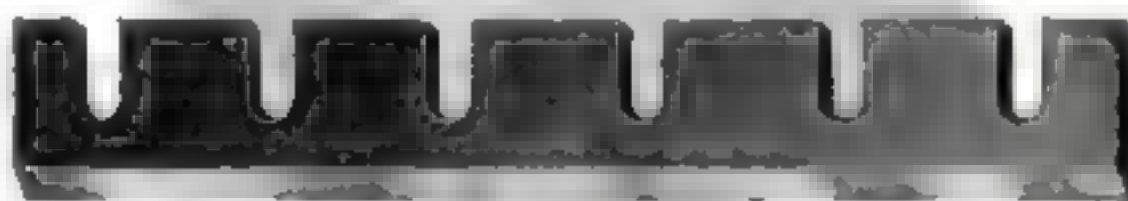
SAWS FILES KNIVES STEEL

PLANER KNIVES

THAT SPEED UP PRODUCTION AND LOWER COSTS

THE best planer man in the world cannot turn out a profitable day's work unless he is furnished with proper cutting edges.

Give him Simonds Planer Knives and watch production speed up. Simonds cutting edges are made of the finest scientifically treated steel and backed by three-quarters of a century's experience in the manufacture of cutting edges that cut costs and lengthen profits. Specify Simonds for economy!



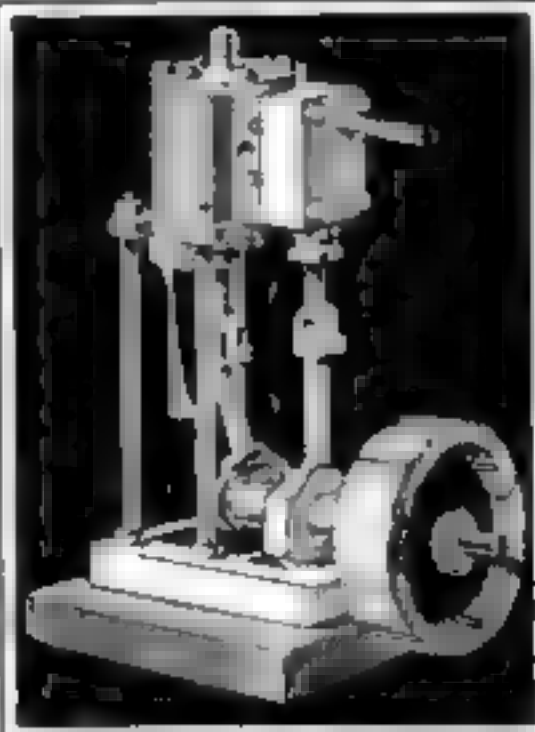
SIMONDS SAW AND STEEL COMPANY

"The Saw Makers"

Fitchburg, Mass.

Established 1852

BRANCH STORES AND SERVICE SHOPS IN PRINCIPAL CITIES



GET A HOBBY

MAKE MODELS

Start a Home Workshop

"Model Making" by R. F. Yates describes the construction of model gas-engines, steam-engines, locomotives, boats, dynamos, turbines, railroads, guns, etc. Thirty chapters are devoted to models of various nature.

It will help you to become a better mechanic. It will help you to do hard soldering, soft soldering, lathe work, tempering, drilling, pattern-making, etc.

This is a book every amateur or professional mechanic and model maker should have.

Model Making describes real engineering models, not toys. 432 Pages, 320 Illustrations. Practical, complete, easily understood. Price Postpaid, \$3.00.

POPULAR SCIENCE MONTHLY
236 FOURTH AVENUE, NEW YORK



TWENTIETH CENTURY

BOOK OF

Recipes, Formulas and Processes

This book of 800 pages is the most complete book of Recipes ever published, giving thousands of recipes for the manufacture of valuable articles for everyday use. Hints, Hints, Practical Ideas and Secret Processes covering every branch of the useful arts are given.

10,000 Practical Formulas—The Best Way to Make Everything

A book to which you may turn with confidence that you will find what you are looking for. A volume of information, up-to-date in every respect. Contains an immense number of formulas that every one ought to have that are not found in any other work.

Price, \$4.00

Popular Science Monthly
236 Fourth Avenue, New York

Patented by Elmer
Radio Corporation
Patented 5-2-38
T-27-38, Phil. Pending

**Control
R. F.
Oscilla-
tions
With**

PHASATROL

**A True Balancing De-
vice for Radio Frequency
Amplifiers**

When building a receiver guard against the squeals and howls of R. F. Oscillations by incorporating Phasatrol in the circuit. If you have a set now, suppress these infernal noises with Phasatrol. It is extremely easy to install without disassembling the receiver. Phasatrol dampens the circuit and absorbs surplus energy thus neutralizing oscillations. By adjusting to the desired value it is possible to tune even the most obstinate R. F. amplifier tube from the per cent to the mill.

Price \$2.75 each.
Electrad specializes in a full line of resistance controls for all radio purposes. Write for free installation circulars and full information.
Dept. S-9
175 Varick Street, New York
ELECTRAD, Inc.

ELECTRAD

CARTER

New Outlet Plate

**FOR AERIAL-GROUND AND
POWER RECEPTION FOR
A. C. SETS**

Finished in
Satin Brass \$1.00
Brown Bakelite 1.25
Etched Bronze 2.25

Folder on complete wiring of house furnished on request

**Carter Radio Co.
CHICAGO**

**THIS 148 PAGE
RADIO CATALOG
AND
ENCYCLOPEDIA
FREE**

Containing 75
radio hook-ups,
500 illustrations,
1000 articles.
Wholesale Prices

Build your own with Radio parts.
The lowest prices in the country.
Radio Specialty Co. 95-P Park Place, New York, N.Y.

Whittled Ship Model

(Continued from page 114)

on the other side and fasten them with pegs. The topmast backstays are hitched to the masthead and fastened similarly. The two stays come to the same place through the holes in the bowsprit and are tied to a hole in the stem, just above the water line.

Fasten the foremast to the mast with a piece of wire through a hole in the inner end of the gaff and a touch of glue down the fore edge. Similarly fasten the boom to the mast touching the rail, and tie the outer corner of the sail to it.

Step the mainmast and rig it in the same manner, affix the mainmast as the foremast. The gaff topmast should be wired to the masthead so that its after corner touches the gaff and the sheet of the clew comes over the gaff and projects down to windward, from there, a rope should run to the deck.

FROM the mainmast head a stay comes to a hole at the fore lowermast head, with another from there to the main lowermast head. Single lines may be fastened from the lowermast heads to the ends of the gaffs, for peak halyards.

Fore and mainsails should have sheets from the boom to the center of the deck, they are apparently to hold them in at an angle shown in Fig. 1, but serve equally to keep them out if the threads are stretched and varnished.

The jibs are tied to their stays with thin cotton through small holes in the edge of the sails. They have sheets made of twisted cotton with blocks in the end, from which two threads lead to the deck. The outer jib has a double sheet, one straight to the deck to hold it down, the other leading over the stay and to the deck on the other side, if varnished, this sheet also helps to keep the sail in position.

The yards should have braces as shown, single ones from the upper yardarms to the masthead, double ones from the next yard to the same place, and double ones from the lower yard to the topmast head. Thin cotton will answer the purpose. Each pair of braces may be of one piece to save knots.

The blocks should not be larger than about 1/16 inch, they may be wood, beads, or merely knots in the thread.

The deck fittings are not much trouble to make and add to the finish. Suitable ones are two little posts right forward, with a round piece between to represent the windlass, a fore hatch, between the masts, and a larger one filling most of the space between the mainmast and the stern, with a raised portion on it to represent the scuttle. Aft of this there is a box containing the steering gear. The little wheel attached to the box may be a small watch sprocket or may be cut from celluloid or lead, it should not be larger than 1/4 inch. Four or more guns and carriages may be fixed on deck to point over the rail.

IF YOUR ship is to be a merchantman, privateer, or slave, it will fly the American flag, but if a pirate, then the skull and crossbones on a black ground or the "Jolly Roger." Mine is a privateer, so I gave it also a long pennant, as with a Navy ship.

If you want to paint her, the coloring is simple—black hull and guns; brown masts and gun carriages; white sails and deck fittings (although the latter may be mahogany color), blue or sea green water with whitecaps. I suggest, however, that you first try her with a thin coat of varnish only, or stained and then varnished. If you do not like this effect, you may still paint her.

When finished you will find that you have a dainty little model. It might be used as a paper weight, or have its base extended to form an inkstand, or be adapted for many other decorative purposes.

YOU CAN'T PLAY A SONNET on half of the Keyboard

AND that is what the majority of people who own Radio sets are trying to do... And the worst of it is that they do not know any better. They have been listening to "Radio Music" so long that their ears have become accustomed to only about half of the program being broadcast.

Now it is possible to transform those sets so that all of the program is heard.

The AmerTran Power Amplifier, a complete 2 stage Push-Pull Amplifier and its companion Unit, the AmerTran Hi-Power Box supplying 500 volts to the plates of the Power Tubes will make your set superior to the finest manufactured sets.

Learn what radio can be—listen to the whole keyboard as it is played in the studio. Write to us now and let us arrange a demonstration for you. No obligation, of course, but prepare yourself for a musical treat.

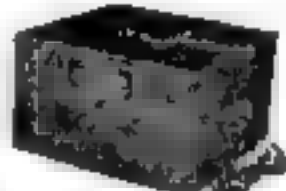
Before you buy a new set—let us show you what your old set, AC or DC, will do when it is brought up to date with AmerTran Products.



AmerTran Push-Pull Amplifier—complete 2 stage audio amplifier. First stage AmerTran Push-Pull for two power tubes. Choice of

standard amplifier or UX 227 AC for 1st stage and two 171 or two 218 power tubes for second stage. Price, post of Rockton—less tubes—\$40.00

AmerTran ABL Hi-Power Box—500 volts DC plate voltage, current up to 118 ma. AC filament current for rectifier, power tubes and sufficient 225 and 227 AC Tubes for any set. Adjustable bias voltage for all tubes. Price, post of Rockton—less tubes—\$95.00



AMERTRAN ©

American Transformer Company
Transformer Builders for over 20 years
212 E. 42nd Street : : : New York, N. Y.

AmerTran Transformer Company,
211 E. 42nd St., New York, N. Y.

Kindly arrange for a demonstration for me.

Name

Address



A LIGHT WEIGHT KNIFE FOR HEAVY WORK

THE blades in this knife are super-sharp—hand-honed at the factory. They are made of the best high-carbon blade steel obtainable, uniformly hardened and tempered to the proper degree. The edge that bites will last. This knife is light in weight. You can carry it in your pocket without knowing it's there, but it is sturdy—built for hard, practical use by carpenters, skilled mechanics and amateur craftsmen.

Has a good-size, heavy gauge clip blade, a pen blade, and a cut-off pen blade for scribing, cutting builder's paper, canvas or other heavy material. Shinbone stag handle with spun rivets—no cracked handles due to hammered rivets. Nickel silver bolsters and shield. Brass linings. Beautiful finish throughout.

Ask for Remington Knife No. R 4413. Sold wherever good cutlery is sold. If your dealer hasn't it in stock, send us his name and \$1.50. The knife will be forwarded promptly, postpaid.

REMINGTON ARMS COMPANY, Inc.

25 Broadway New York City
Originators of Kleanbore Ammunition

Remington

©1935 R. A. Co.

1935

22 Cal. Blank Automatic

WITH 100 rounds of ammunition. No Permit Required.

FREE 6 SHOT

Instantly as a gift. Absolutely safe. Send no money. Write for Booklet A-10 Showing This and Other Models.

JENKINS, 622 Broadway, New York, Dept. 91 J-2

Sport Bodies for Fords
at FACTORY PRICES!

This Model for \$38.50

Write for Booklet A-10 Showing This and Other Models.

SPORT FACTORIES, Aurora, Illinois

Air Time-Tables

(Continued from page 29)

airport supplement the regularly scheduled airlines; you can rent from the companies operating them a plane and pilot for any local or cross-country trip where the regular air service is inadequate. Thus, Dr. John MacLachlan, of Cleveland, Ohio, used a taxi plane the other day to make a fast trip, without need of connections, between Cleveland and Hartford, Conn. Called to attend a seven-month-old baby stricken with influenza in Hartford, the family physician arrived by air in time to save her life by warding off toxic complications.

Not only independent companies, but many regular air lines operate these taxi services. Their rates vary from fifteen cents to a dollar a mile for each passenger; for long trips the rate is generally higher.

THERE is no mystery about taking a trip by air. In every city along a regular air passenger route is a local office of the airline serving it that will gladly furnish information, rates, and directions to reach the field. If the name of the airline is unfamiliar, it can usually be obtained from telephone information, the local Chamber of Commerce, a leading hotel, or any newspaper. In the same way you can learn the name of an air taxi service. It is prudent to make sure your pilot is a licensed operator flying a licensed plane.

A ride over the transcontinental airway, backbone of the nation's whole system of air lines, is one of the best illustrations of the advantages—and disadvantages—of air travel today. Suppose, for instance, that John Jones wants to cross the continent by air from New York to San Francisco, passing through Chicago en route. He learns that the National Air Transport, carrying mail and express and accommodating one passenger a day when load and weather permit, runs the only scheduled line from New York to Chicago, there it connects with the Boeing Transport line, longest passenger line in the country, for the remaining 1,248 miles. Of course, Jones could hire at Curtiss Field, N. Y., or Hadley Field, N. J., a taxi plane that would take him to any part of the country at a fixed rate of, say, fifty cents a mile but that is considerably more than the mail line's rate of \$80 to Chicago.

At nine in the morning, Jones telephones the National Air Transport and learns weather conditions will permit the Chicago flight. However the manager must wire Cleveland to make sure that no one else has booked passage from there to Chicago. Otherwise, with the line's one-passenger capacity, Jones could not travel straight through.

THE answer from Cleveland is satisfactory and at 10:15, Eastern Standard Time, Jones boards a Pennsylvania R. R. train for Newark, N. J. There he changes to the local that will carry him to Stelton, a little flag station near New Brunswick, N. J., where Hadley Field, the airline's eastern terminus, is located. He is carrying a small suitcase; only twenty-five pounds of baggage is allowed him without extra charge, and that is the rule with most air passenger lines.

A FIELD manager meets Jones to the field. Soon a new airport at Newark, only half an hour from New York, is to be ready; and it seems likely that air lines serving New York will move to the new terminal at once.

At Hadley Field Jones pays his passage and receives his air ticket, a little larger than a postcard. Now he dons flying togs that the manager provides for him—suit, helmet, goggles, and boots if the weather is cold. He straps on a parachute, in an emergency, he is instructed, he will jump first, count ten, and pull the cord that

(Continued on page 125)

Stop That Pain

WITH THIS GREAT NEW INVENTION

What Users Say

Read what the famous Dr. J. C. ... says about this new invention. It is a great relief to the pain of rheumatism, neuralgia, and other painful conditions. It is a great relief to the pain of rheumatism, neuralgia, and other painful conditions. It is a great relief to the pain of rheumatism, neuralgia, and other painful conditions.

Free Trial

If you want more health—greater power—to enjoy the pleasures and delights about you, ask for the book on this invention which has been prepared. It will be sent to you without cost. It tells you how to use the Health Generators and how to use the Health Generators and how to use the Health Generators.

They operate on the electric light in your home or on their own motive power at less than 50 cents per year. The Health Generators are positively the only instruments which give you in one outfit Electricity, Violet Ray, Vibration and Ozone—the four greatest curative agents. Send the coupon below. Get the Free Book NOW!

Free Book

Do not put this paper down without reading the book. It is a great relief to the pain of rheumatism, neuralgia, and other painful conditions. It is a great relief to the pain of rheumatism, neuralgia, and other painful conditions. It is a great relief to the pain of rheumatism, neuralgia, and other painful conditions.

Lindstrom & Company
30 West Lake St., Dept. 134 Chicago
Please send me your free book "Health-Power-Beauty" and full information of your Free Trial Offer.

BUILD YOUR OWN CLOCK

These fine home built clocks are sold in building blocks, are just like clock store clock. We furnish plans, parts, tools, work, clock and all materials at low prices.

Banjo Clocks, Mantel Clocks, Works As Low As \$1.95, Grandfather Clocks with Chimes

Write for Catalog and FREE Blueprint Plan.

American Chime Clock Co. 1801 E. Rodney Street, Philadelphia, Pa.

MODEL AIRPLANES

"Baby Plane" takes off ground, flies fast and far. Wing spread 20 inches. Length 10 inches. Finished all complete. \$2

"Construction Kit" everything needed to make a fine model. With instructions and full plans. \$2

FREE AVIATOR'S HELMET

Illustration: The first flight of a model airplane. All materials and instructions. \$1.95. Write for details or blueprint. **Broadfield Airplane Co.** Dept. 11, Remond, N. Y.

The Electrician's Wiring Manual

By F. E. SENGSTOCK, E. E.

Contains all the information needed for the proper installation of lighting and power systems in homes and other buildings. It completely covers inside electrical wiring and construction in accordance with the National Electric Code.

Packet also—flexible binding. 448 pp. Price, \$2.50

Air Time-Tables

opens it. That is an almost unnecessary precaution that has an interesting origin, mail pilots, although they are required to wear parachutes, must still, according to the best traditions of the National Air Pilots' Association, stick by a disabled ship unless the passenger's safety is also provided for.

Jones is escorted to the plane he will ride in, a Douglas single-seater mail plane. A folding rumble seat, with a windshield that also folds, has been improvised in the space just ahead of the pilot and behind the motor; into this seat Jones climbs, molding to the pilot, and mail and express is piled in. With a roar of the motor the plane is off.

At his side Jones notices a little telephone. He holds it to his ear and over it comes the pilot's voice, clear above the racket the motor is making. Jones can converse with him without raising his voice. "Now we're passing the Kittatinny Mountains," says the pilot. A little later, "Here we are, over the city of Reading."

FROM an altitude of about a thousand feet, Jones has a magnificent view of the country. Passing over western Pennsylvania, his pilot-guide points out a carved-in mine. No pilot ever fails to point out that mine, it seems; it is a perennial attraction.

The pilot vouchsafes that he has flown the mail route for thirteen months and he knows every farm. Jones' talk with him is interrupted, he dips his plane, lands at Cleveland, and points out the machine to which Jones must change for his trip onward to Chicago.

Three thirty-five, Central Time—on time to the minute. "Have I time for a bite to eat?" Jones asks. "That's easy," says his pilot, pulling mail bags from the plane. "You can get a lax lunch over there at the field office."

Munching a sandwich, Jones climbs aboard the second plane, with a new pilot. A brief stop at Toledo to drop a mail sack, and then promptly at seven o'clock, Chicago's municipal airport at Cicero, Ill., comes into view.

Fifty minutes rest, before the Boeing plane's scheduled departure westward, gives Jones a chance to stretch his legs, pay \$8.00 for a ticket to San Francisco, and inspect the field with its two hangars, one brick office building, and a manager's small office. A roar overhead attracts his attention, and a Travel Air cubic monoplane swoops down from the sky. It is the National Air Transport passenger and mail plane from Kansas City, on time at 7:20. Five hours sufficient for that trip, though it takes twelve by train. Three passengers step out, carrying suit cases, as it glides to a stop, and are whisked away in a taxicab.

AT SEVEN-FIFTY, the Boeing plane, a two-passenger cabin machine—precursor of twelve-passenger Fokkers soon to ply the route—soars into the darkening air. Jones settles back on the leather-covered seat for two, at the front of the mail compartment soon he is sound asleep. A bump and he opens his eyes, startled. The plane has landed at Iowa City for gas.

Omaha next, with a change of planes and a midnight snack of coffee and cookies at the airport. Now Jones can keep his eyes open no longer. Unseen by him, through the night, his pilot flies on to stop at North Platte . . . Cheyenne. Another change of planes; few fly more than 400 miles at a stretch. Hitting the Rockies now, in the gray light of dawn.

Seven in the morning, and he circles to a landing at Rock Springs, Wyoming, to take off again immediately. Morning sunlight bathes the scenery more than a mile beneath in a brilliant glow. For a while Jones watches it scud past, then (Continued on page 130)

Yes! —and— There is MONEY for YOU if

You get Thorough Training Now!

Aviation is the fastest growing industry in the world today—offering unlimited opportunities as a commercial pursuit and unsurpassed enjoyment if flying for pleasure alone. The beginner NOW can be the master of aviation a few years hence. There is honor and prosperity ahead for those who start now with proper training and grow with the industry. Our courses give you this training—they cover EVERYTHING about planes, motors, their maintenance and construction, etc. EVERYTHING a pilot or mechanic must know to secure a good paying position.

We Teach You by Practical Instruction



Thorough Instruction at Low Cost

We teach you by actual flying and practical instruction, to bring you to the point where you can make each student master of his ship; pilot it safely and efficiently. That our instruction is thorough is proved by the fact that each student, before finishing the course, must take off, fly and land his plane without assistance. No student bond required. Our ground courses give thorough instruction in ground work and qualify you for a position as motor and plane mechanic, rigger, electrician, welder or any ground position, if you can take the course combining ground instruction and flying which will qualify you for an industrial licensed commercial or transport pilot. The cost is low considering daily flying and thoroughness of the instruction and should instruction on latest modern type planes. Wright Whirlwind and other standard motors. Fly by new book "Aviation and You" (tells all the facts. It's FREE! Fill out the coupon and mail it at once—no obligation. DO IT NOW!

Von Hoffman Aircraft School,
Lambert St. Louis Field,
Anglem, Mo.



Our School Registered, All Instructors and Airplanes Licensed by U. S. Government, Aeronautics Branch, Dept. of Commerce. Realizing that the highest type of equipment and ablest and most experienced instructors are necessary, our courses are taught under the direction of U. S. Licensed Transport Pilots and Mechanics. Our equipment is new and of modern design, every ship is licensed and instructors and all equipment subject to daily U. S. Government inspection. (Most schools do not have a resident Federal U. S. Government Inspector on the field—think what this means to you.)

How to Own Your Plane Get Our Course Free

Write for our plan which will enable you to own your plane and secure work for it, and you a complete course of instruction.

Von Hoffman Aircraft School,
207 Lambert-St. Louis Flying Field (Lindbergh's Own Field),
Anglem, Missouri.

Send me your big, new book "AVIATION AND YOU" giving all the facts about your ground and flying courses. I assume no obligation.

CHECK ☐ I am interested in GROUND COURSE HERE ☐ I am interested in FLYING COURSE

Name _____

Address _____

Town _____

Age, _____

State _____

The Electrician's Wiring Manual

By F. E. SENGSTOCK, E. E.

Contains all the information needed for the proper installation of lighting and power systems in houses and other buildings.

It completely covers inside electrical wiring and construction in accordance with the National Electric Code. Pocket size—flexible binding.

448 pp.

Price, \$2.50

POPULAR SCIENCE MONTHLY
250 Fourth Ave. New York City

DIESEL ENGINES Marine and Stationary

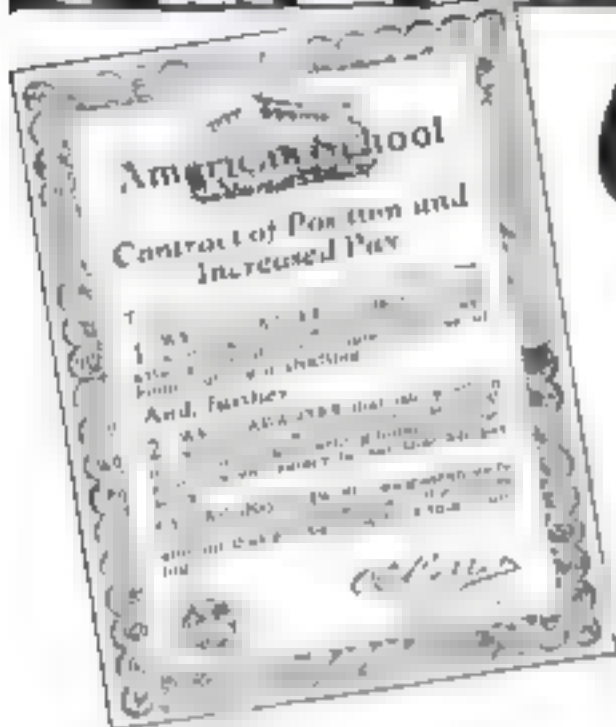
By Ensign DAVID L. JONES, U. S. Navy



The most complete, thoroughly practical and up-to-date treatise on the Diesel Engine ever published. It explains their construction, troubles, remedies, operation and adjustment. Practical trials and tests and elementary thermodynamics of all types of the Diesel Engine. The book is fully illustrated with drawings of working parts and detail engravings. 400 pages.

Price \$5.00

Popular Science Monthly
250 Fourth Ave. New York, N. Y.



Come into Drafting!

Men who can read blue-prints and draw plans are "sitting pretty" these days. No wonder, when you consider that every machine, every building, all industrial activities start on the Drafting table! Intensive production, record-breaking construction operations, have created a great demand for expert Draftsmen capable of designing and calculating original plans.

\$50 to \$125 a week paid to Expert Draftsmen

Get this point—that Drafting isn't just one line of work—it reaches out into the Electrical, Manufacturing, Building Construction, Automotive and Structural industries. That is why you'll find well-paid Drafting positions advertised in all industrial centers of the U. S. 70,000 vacancies reported in the past 12 months. And that is why I advise men to go into Drafting, particularly if handicapped by lack of high-school or college education.

The Entering Wedge to Success in all Building and Manufacturing Lines

I recommend Drafting, too, because it can be QUICKLY learned at home in spare time—without quitting your job without having a day's time or a dollar to pay. Present you're sure there will be a good position waiting when you are ready for it. And because the work is so fascinating and offers better than ordinary chances for advancement. For the Draftsman is in close contact with important work and BIG MONEY, and he is right in line for promotion to Superintendents and other executive positions.

3 Drafting Lessons! Actually FREE!

to prove you can learn at home, in your spare time!

You will never have a more serious personal problem than deciding your future life-work—so we merely urge you to LOOK INTO

Drafting. See how you like it, see if you learn as readily as most men do, get the facts about the opportunities, the salaries paid, the jobs open, the chances for promotion.

That is why, on receipt of your name, we will send you the first three lessons of our Drafting course without cost or obligation.

A Drafting Job paying 50% more than you earn today—without risk!

Now, at a cost you can afford, on terms of only \$6 per month, you are sure of getting a fine Drafting position and a substantial increase in pay. A million-dollar institution guarantees both—the training, then the employment service. Under money-back penalty.

This agreement brings you your SECOND CHANCE. To repair a neglected education, to specialize, to change to a line where you can get ahead more rapidly. Read it, and investigate it!

The American School

Chartered 31 years as an EDUCATIONAL institution and like the best resident schools and colleges, conducted NOT FOR PROFIT. We offer complete, thorough up-to-date instruction, built by 200 leading Educators, Engineers and Executives. A unique instruction, built to meet the specifications of well-paid jobs as laid down by employers themselves, yet simplified for ready understanding by men with only common schooling.



O. C. MILLER
Director Extension Work

And we are the first in the home study field to recognize the need of giving a COMPLETE SERVICE to ambitious men, from the first step to employment. Which has helped us as you are, supplies the equipment you lack and leads you to the better job you seek. Without risk to you!

And we are the first in the home study field to recognize the need of giving a COMPLETE SERVICE to ambitious men, from the first step to employment. Which has helped us as you are, supplies the equipment you lack and leads you to the better job you seek. Without risk to you!

The American School

Dept. D-675 Drexel Ave. & 58th St., Chicago, Ill.

O. C. MILLER, Director Extension Work,
THE AMERICAN SCHOOL,

Dept. D-675 Drexel Ave. & 58th St.,
Chicago, Illinois

Please send, without cost or obligation:

1. Three Drafting Lessons.
2. Facts about the opportunities in Drafting.
3. Your agreement to train and place me under money-back penalty.

Name _____

Address _____

Age _____

Occupation _____

LEARN RADIO

and find

**Good Pay from the Start,
Rapid Advancement and
Phenomenal Success in
A Life Profession of
Fascinating Brain-work.**

You Can Learn At Home!



R. L. DUNCAN,
Director, R. I. A.

Here is your big opportunity! Our graduates are earning big money as radio designers, as radio executives in broadcasting work, as skilled service men and radio dealers. We have trained thousands to become successful radio operators on ships and in shore stations. And now opportunity is knocking at your door. Are you going to plod along at a thirty-five dollar a week job when **REAL MONEY** is waiting for you in radio?

A New Course

After years of experience the Radio Institute of America has evolved a new and revolutionary course in radio—right up to the minute and abreast of the most recent developments in the radio industry.

It starts with the very fundamentals and takes you through every phase of radio—right through television, photoradiograms and airplane radio equipment.

The instruction is the work of radio experts and its clearness and simplicity are such that you can master every point with ease. You take examinations and your papers are corrected by men with years of radio experience. All your questions are answered and you are in contact with the Institute at all times.

A-1 Equipment

A large kit of first-quality equipment is included in the cost of the course—without extra charge—parts for making a hundred different radio circuits and the Peerless Signagraph and key and buzzer set for code instruction.

**R. I. A. backed by RCA, G-E
and Westinghouse**

Conducted by RCA and enjoying the advantages of RCA's associates, General Electric and Westinghouse, the Radio Institute of America can and does give the finest radio instruction obtainable anywhere.

Home Study Course



Moreover, you can **STUDY AT HOME**—when you please and as long as you please.

This new booklet describing the course is now ready. If you want to learn more about the lucrative and fascinating profession of radio send the coupon now for your copy.

RADIO INSTITUTE OF AMERICA
Dept. J-9, 326 Broadway, New York City

RADIO INSTITUTE OF AMERICA
Dept. J-9, 326 Broadway, New York City

Dear Mr. Duncan:

Please send me your new catalog. I want to know more about your new radio course.

Name _____

Address _____

Air Time-Tables

(Continued from page 126)

looks at his watch. Breakfast awaits him at Salt Lake City.

A split appears in a range of peaks, the Wasatch Mountains, that cross the magnificent panorama. Through the gap the plane sails, and Salt Lake City flashes into view far beneath.

At ten o'clock Jones' craft lands beside a pair of planes on the Salt Lake field. They are warming up already awaiting transcontinental mail and express. One, a Western Air Express open mail plane, will forward mail to Los Angeles and take along a passenger or two if any desire. The other, a northbound plane for mail only, is due in Pismo, Washington, seven hours later. It is one of the only four airlines in the country, of the thirty-six in operation at this writing, that do not carry passengers.

THE mail transfer made, Jones' plane crosses the desert, stopping at Elko, Nevada, Reno, and, after passing the Sierra Nevada peaks, at Sacramento, Calif., only two hours from its destination. And at four-thirty in the afternoon, Pacific Time, Jones steps from the plane at Oakland, Calif., the line's western terminus, to motor to Alameda and cross by Southern Pacific ferryboat to San Francisco. His transcontinental trip, costing \$400—a figure that may be reduced to \$300 before long—was made in a little more than thirty hours elapsed time, including stops. In other words, he has arrived in San Francisco at the same time that a rail passenger who left at the same time he did, from New York, would still be in Chicago waiting for a fast overland night train.

That is speed. True, it may be disconcerting to learn that you must travel in an open cockpit from New York to Chicago, subject to removal by the pilot at any time if weather threatens; though the trip has not daunted a number of women, one of whom embarked by air from New York to Santa Barbara, Calif., for a golfing vacation.

AND now the last objections are to be removed. Within six months, the National Air Transport announces, it plans to have in operation a luxurious passenger service between Chicago and New York. It has just set aside half a million dollars to buy planes that will carry from fourteen to twenty passengers each. Buffet luncheon will be served on board and two pilots will relieve one another at the controls. Cabins will be roomy, and passengers can recline and even sleep in Pullman type chairs. Soundproof walls will deaden the roar of motors outside. Like the present line, the new one's route will be via Cleveland, with a connecting line to Detroit. At present, day service is planned, with future addition of night passenger planes.

Two other important improvements are in sight for the transcontinental route. Completion of the Department of Commerce's night flying program will now permit night flying across the whole distance, with added planes. And before many months, a projected air-rail line across the continent will be a reality, and a two-day trip by day-flying airplanes and night trains equipped for sleeping comfort will be an important adjunct to the all-air route.

In short, we are just entering an era of air travel. Is it safe? Not an accident in 1,000,000 miles of flying, one airline reports. Convenient? Airports, today, are none too easy to get to, but it's worth the trouble in time saved and the pleasure of a speedy trip. Fast? A hundred miles an hour. How do you start? Just pick up a phone and call the airline's nearest office for time-tables, rates, and directions.

And that is all there is to it.



Keep Your Copies of "POPULAR SCIENCE" in the New Big-6 Binder

There is so much useful information in Popular Science Monthly that many readers have asked us to supply them with a binder in which they can keep a permanent file.

To meet this demand we have had designed the binder pictured above. Bound in two-tone Aircraft (looks like leather—lasts forever) with the name of the magazine stamped in 14 Karat Gold on the cover, this binder will securely hold 6 copies of Popular Science Monthly.

New copies can be slipped into the Big-6 Binder as easy as inserting a letter in an envelope.

There is nothing to get out of order—no screws to work loose, no keys to get lost. This binder will last a lifetime.

The binder is as beautiful as it is useful—it will be an ornament to any library table.

Only \$2.00—Postage Prepaid

Bought in a store this binder would cost you \$3.00 or more. Because we are having them made in quantity for our readers we can make you the special price of \$1.00 including all delivery charges.

Popular Science Monthly,
74 Fourth Avenue,
New York, N. Y.

Please send me your Big-6 Binder bound in two-tone Aircraft with Popular Science Monthly stamped on the cover in 14 Karat Gold. I am enclosing \$1.00 and it is understood that there is to be no further charges of any kind.

Name _____

Address _____

The Month's March in Science

(Continued from page 86)

safely expose your legs and arms out of doors.

Another instrument perfected by Doctor Burt employs a photo-electric cell to measure the intensity of ultra-violet light from the sun at any moment. This intensity varies from day to day. Dr. Edison Pettit of the Carnegie Institution, Washington, says that it has varied more than fifty percent in the last few years, due to changes in the sun itself, and to variations in the earth's atmosphere.

Of this new measuring instrument, Doctor Burt says: "It is so portable and easy to use that the day may come when up-to-date bathing beaches will have observatories to give out the intensity of sunburn light in the sun."

Fossils 600,000,000 Years Old

IN AUSTRALIA, a few weeks ago, was written an epic of the progress of life on earth, from crawling worms to flying men.

At about the time Captain Kingsford-Smith and his comrades were alighting at Brisbane after a record ocean flight across the Pacific, there was announced the discovery, in Australian mountains, of the fossilized remains of the oldest known inhabitants of the earth, who lived some 600,000,000 years ago. Lowly creatures, never before seen, they resembled the sand worms found on modern beaches, and crayfish.

The oldest fossils previously found lived in the Cambrian Age, the earliest period of the age of fishes and invertebrates, probably somewhat less than half a billion years ago.

The new discovery was made with a high-powered microscope by Lieut. Col. Sir Edgeworth David, a former professor of geology at Sydney University, after a search of more than twenty-five years.

It has been hailed by one authority as "opening a new epoch in geology, antedating the birth of life beyond the wildest conjectures of the geologists."

Telescope May See Martians

PROF. G. W. RITCHIEY, noted American astronomer, predicts that within the next eight years the world will know whether there are cities and men in the planet Mars.

Professor Ritchiey supervised the design and construction of the 100-inch reflector for Mount Wilson observatory, largest in the world. Now, in Paris, he is planning a giant telescope of entirely new design and ten times more powerful.

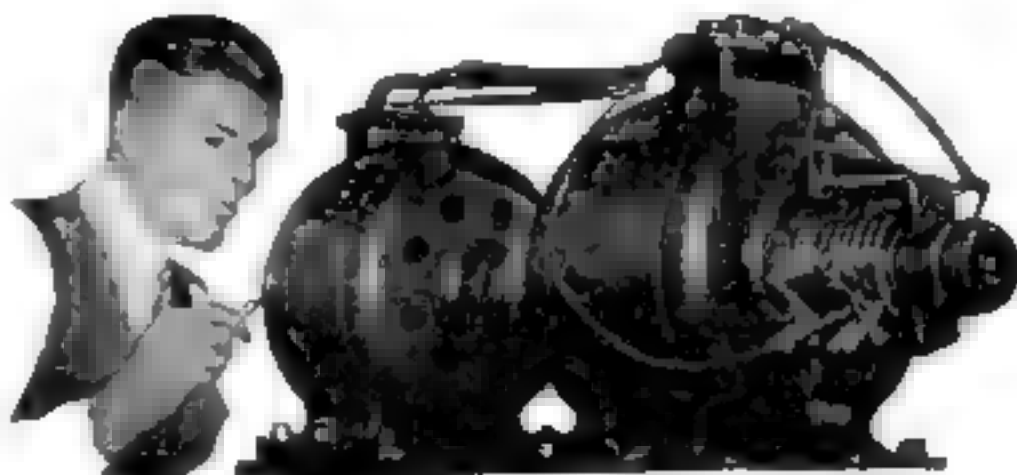
"The largest number of stars which present telescopes have been able to photograph in one cluster," he explains, "has been about 40,000. The new telescope will photograph millions. It will be able to show clearly any densely populated sections of Mars, if they exist."

The telescope will have a mirror nearly twenty feet in diameter, and its construction will be based on Ritchiey's discovery of a method of building mirrors of several separate pieces of glass, instead of one huge piece, as told in a previous issue of POPULAR SCIENCE MONTHLY.

Present plans call for a huge observatory beside the Grand Canyon in Arizona.

Events move swiftly in exploration of the sky. And public interest in astronomy grows apace. Reports from Germany say that crowds of American tourists have been flocking to the planetariums established in Berlin and thirteen other cities.

On the white domes of these remarkable man-made heavens, they have seen displayed the fascinating pageant of the stars. Within a year a similar planetarium will be erected in Chicago. Other cities, too, plan to follow the story of the stars.



AMAZINGLY Easy Way to Get into ELECTRICITY

Don't spend your life waiting for \$5 a week in a dull, hopeless job. Now . . . and forever . . . say good-bye to 25 and 35 dollars a week. Let me show you how to qualify for jobs leading to salaries of \$50, \$40 and up, a week, in Electricity—NOT by correspondence, but by an amazing way to train, that makes you a practical electrician in 90 days. Getting into Electricity is far easier than you imagine!

Learn on Actual Electrical Machinery in 90 Days

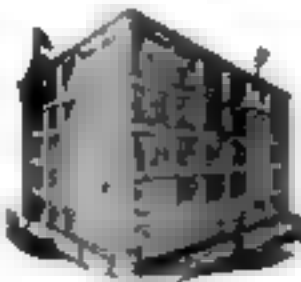
Lack of experience—age or advanced education have no one. I don't care if you don't know an armature from an air brake—I don't expect you to. It makes no difference! Don't let lack of money stop you. Most of the men at Coyne have no more money than you have. That's why I've worked out my astonishing offer.

FREE Employment Service

Many of my students earn a good part of all their living expenses and should you need this assistance we will help you. Then, in 12 brief weeks, in the great training shops of Coyne, I train you as you never dreamed you could be trained. On one of the greatest outlays of electrical apparatus ever assembled . . . real dynamos, engines, power plants, autos, switchboards, transmitting stations . . . everything from doorbells to farm power lighting . . . full-sized . . . full operation every day.

Now in Our New Home

This is our new fireproof, modern home, where is installed thousands of dollars worth of the newest and most modern Electrical Equipment of all kinds. We now have a larger amount of floor space devoted to the exclusive teaching of practical electricity. Every comfort and convenience has been arranged to make you happy and contented during your training.



Prepare for Jobs Like These

Armature . . . 2 a week
Auto Electrician . . . 3 a week and by
Refrigerator . . . 4 a week and by
Generator . . . 5 a week and by
Refrigerator . . . 6 a week and by
Refrigerator . . . 7 a week and by
Refrigerator . . . 8 a week and by
Refrigerator . . . 9 a week and by

Not a Correspondence School

Learn by doing . . . all real actual work . . . building real batteries . . . winding real armatures, operating real motors, dynamos and generators, wiring houses, etc. That's a glimpse of how we help to make you a practical electrician, and fitting you to hold big jobs after graduation.

Jobs, Pay, Future

Don't worry about a job. Coyne training settles the job question for life. Big demand for Coyne trained men. Our employment department gives you lifetime service. Two weeks after graduation, Clyde F. Hart got a position as electrician with the Great Western R.R. at over \$100 a week. That's not unusual. We can point to many Coyne men making up to \$500 a month. \$50 a week is only the beginning of your opportunity. You can go into radio, battery or automotive electrical business for yourself—and make \$3000 a year and up.

Get the Facts

Coyne is your one great chance to get into electricity. Every obstacle is removed. This school is 29 years old. Coyne training is tested, proven beyond all doubt—endorsed by many large electrical concerns. You can find out everything absolutely free. Simply mail the coupon and let me send you the big free Coyne book of 150 photographs . . . facts . . . job . . . salaries . . . opportunities. Tells you how many earn expenses while training and how we reward graduates in the field. This does not obligate you. So act at once. Just mail coupon.

Get this FREE Book!



COYNE Electrical School

H. C. Lewis, Pres.

Dept. 43-23 Established 1899

500 So. Paulina St., Chicago, Ill.

Mr. H. C. Lewis, Pres.
COYNE ELECTRICAL SCHOOL, Dept. 43-23
500 S. Paulina St., Chicago, Ill.

Dear Mr. Lewis:
Without obligation send me your big free catalog and all details of Free Employment Service, Radio and Automotive Courses, and how many earn while learning. I understand I will not be bothered by any salesman.

Name

Address

City State

Tips from a Veteran Carpenter

(Continued from page 32)

molding, and even door and window frames. Common yellow pine may be used to case a window on the outside right next to cedar clapboards, which is like a fake diamond set in platinum. Some fellows vamp window, door, or screen frames out of any kind of scrap lumber from poplar to whitewood. They put the right stuff in the wrong place, like a tailor who sews the lining on the outside of a coat. It looks just as good when painted, but time shows up the make-believe. This is why it pays to deal with reliable lumber dealers and builders."

"Some persons put a lot of faith in paint," I observed.

"Paint never gets to the inside of a frame after it is set in a wall," said Uncle Ed. "One priming coat generally has to last the hidden part for a lifetime, but moisture gets in and if the wood isn't naturally rot-proof, there's trouble."

"**S**AME thing with all exposed woodwork, including boards behind gutters, porch floors, and steps. Besides that, where paint is a protection it wears off and the naked wood has to take the punishment of the weather until the owner gets around to covering it again. The other day I saw rain going right through unpainted cedar siding—the best of material, but porous and sliced too thin on the upper part. That's another modern improvement to look out for, reducing the old-time thickness of lumber in clapboards, flooring, trim, and I don't know what else. One inch was pared to seven-eighths, then to three-quarters and one-half minus. The latest is closet lining veneer that needs a micrometer to measure it."

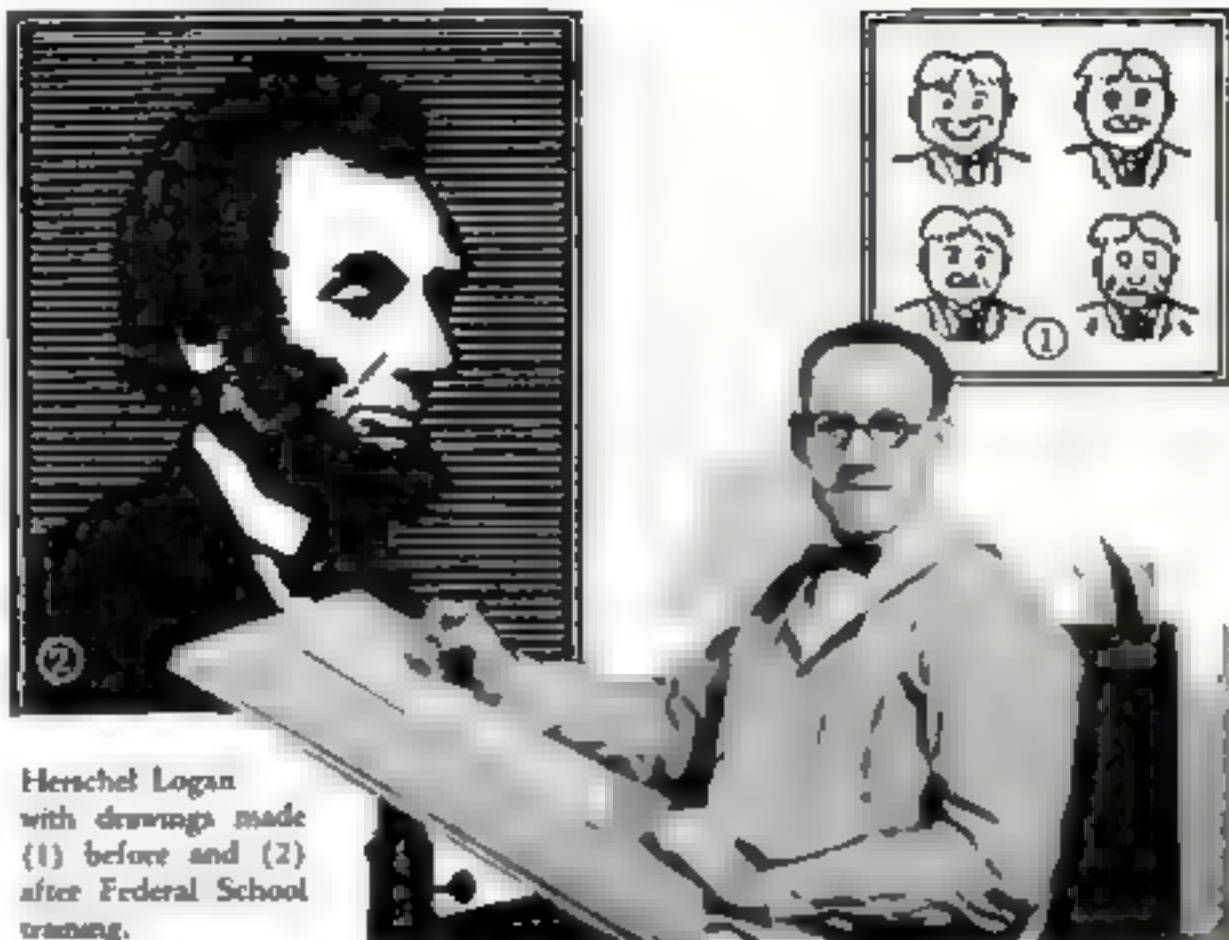
"And could be applied with carpet tacks."

"That's another point, the way some houses are tacked together with the smallest and fewest nails. When you don't hear a healthy racket on a new house and the hammer sound like a hand at a funeral, you can guess that the nailing is being skimped. I like plenty of spikes in framing, and not less than tenpenny nails in studs and rightpenny finishing nails in trim. The extra long nail is not always to provide strength, but to hold tight material tight against warping."

"Flashing over exposed doors and windows is something that many persons never heard of," I suggested.

"**I**T USED to be done on all good jobs and is yet. Perhaps I oughtn't to complain about lack of flashing, because that gives me a good many days of repair work every year. Our windows are leaking badly on the inside top and sides, Mr. Warner," folks say over the phone. Please come and fix them right away. It's raining and they think I can stop the trouble in a jiffy. The plaster is stained inside, the drip cap outside is probably rotted. It's a slow and expensive job that would never happen if a few extra dollars had been spent on the house in the first place. This trouble is more likely to happen with siding than where the wall is shingled. A film of water collects on the drip cap above the window and is blown under—the joint not being tight when new or worked open by shrinkage later. Then the water runs down the inside of the frame and even into the house. Flashing is a metal strip nailed to the sheathing, bent over and under the drip cap and nailed just below it. It can be handily bent to shape on a two-by-four before putting it in place. The old houses used tin, but now we have copper as the first choice. A dollar's worth of copper on a window will save ten dollars in repairs. Zinc is all right, but does not mate well with the acids in cedar siding or shingles."

"I guess you believe in copper for other flashing, too—in roof" (Continued on page 134)



Herschel Logan with drawings made (1) before and (2) after Federal School training.

DRAWING turns INK to GOLD

HERSCHEL LOGAN wanted to make money. He liked to draw, but his work (an example of which is shown in No. 1, the small crudely drawn heads above) was not good enough to sell. Seeing an advertisement of the Federal Schools, he filled out a coupon like the one at the bottom of this page. Now compare his recent work, No. 2, with the crude ink scratchings he did before he enrolled in the Federal Course. The drawing of Lincoln shows that Logan understands the proper application of ink. You can see for yourself how the Federal Course has "steadied" his hand. This is the type of drawing that is simple, strong, masterful and pays big money to the man who can do it. Mr. Logan is just one of hundreds of young people making good money because of Federal Training.

Publishers buy millions of dollars worth of illustrations like Logan's, every year. If you like to draw let your talent make your fortune.

Such famous artists as Sid Smith, Fontaine Fox, Neysa McMein, Herbert Johnson, Clare Briggs, and over fifty others contribute exclusive lessons and drawings especially prepared for the Federal Course. It's easy to learn the "Federal Way." Study at home in your spare time.

Test Your Drawing Talent

Many people have a talent for art and do not realize it. It is well proven by Logan's first work compared with his drawing of Lincoln. Do you like to draw? A liking for drawing usually indicates talent which can be developed. Our Standard Vocational Art Test will tell you just how much ability you have. Send for it, it's free. We will enclose with it our illustrated booklet, "A Road to Bigger Things," which explains illustrating as a profession, tells about famous artists who have helped build up the Federal Course and shows the remarkable work of students. You'll want both the booklet and the test chart. Fill out the coupon now.

Federal School of Illustrating

FEDERAL SCHOOL OF ILLUSTRATING.

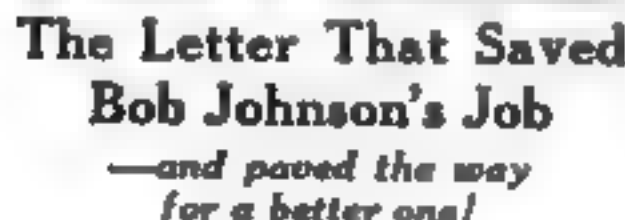
9148 Federal School Bldg., Minneapolis, Minn.

Please send your free book, "A Road to Bigger Things," together with your Standard Vocational Art Test.

Name _____ Age _____

Occupation _____

Address _____



Won't you let the I. C. S. help you, too? With a
you trade a few hours of your spare time for a good
job, a good salary and the comforts that go with it?
Then mark the work you like best on the coupon be-
low and mail it to Bureau on Friday. That doesn't still
leave you in the least, but it will be your first big step
toward success. Do it now!

Don HIND, E. Barnston, Pym.

THE UNIVERSITY OF CHICAGO PRESS

<input type="checkbox"/> Business Management	<input type="checkbox"/> Advertising Art
<input type="checkbox"/> Principles of Management	<input type="checkbox"/> Typographic Composition
<input type="checkbox"/> Personnel Management	<input type="checkbox"/> Store and Layout
<input type="checkbox"/> Traffic Management	<input type="checkbox"/> Window Display and Telling
<input type="checkbox"/> Bookkeeping Finance	<input type="checkbox"/> English
<input type="checkbox"/> Management	<input type="checkbox"/> Review
<input type="checkbox"/> Accounting (incl. C.P.A.)	<input type="checkbox"/> Railway Mail Clerk
<input type="checkbox"/> Cost Accounting	<input type="checkbox"/> Sales Clerk
<input type="checkbox"/> Bookkeeping	<input type="checkbox"/> American Retail Methods
<input type="checkbox"/> Specialized Work	<input type="checkbox"/> High School Subjects
<input type="checkbox"/> Spanish <input type="checkbox"/> French	<input type="checkbox"/> Drawing Artistic
<input type="checkbox"/> Salesmanship	<input type="checkbox"/> Lettering
	<input type="checkbox"/> Numbering

[illegible]

Occupation
If you reside in Uganda, send this coupon to The International Correspondence Schools, Limited, Aldershot,
Hants.

(Continued from page 155)

That's a question that Shem, Ham, and Japhet started to argue on and folks are still at it," declared Uncle Ed. "You can't keep human nature away from what looks like a bargain. The wreckers and junkmen always have customers. You can't expect a carpenter to say he likes second-hand lumber any more than a cook likes to make a banquet out of leftovers. It is hard on tools and temper. The old stuff is full of nails that sock places and ruin saws. It has split ends that call for makeshift tacking together or cutting off with wastage. It has such a mixup of odd sizes that the carpenter wears himself out figuring how to match this and that. He is always ripping, lapping, shimming, and patching. It takes more than twice as much time and a few more kegs of nails compared with straightaway work on new lumber."

"It makes no difference, if the builder is honest," replied Uncle Ed. "But if you decide to contract, keep away from the lowest bidder if you want a job of first quality."

By making X-ray photographs of ancient Egyptian mummies in the Field Museum, Chicago, Dr. Corn A. Matthews, of the staff of the Cook County Hospital, has been able to determine that children who lived in the time of the Pharaohs suffered from many of the diseases that are common among children today.

[illegible]

1. **Author:** Anne S. Hays, Editor, *Journal of the American Dietetic Association*, 1994, 94(10):1000-1001.

AMERICAN SCHOOL OF PHOTOGRAPHY
Dept. 1366
1401 Michigan Ave. Chicago, Ill. U.S.A.

MAKES BIG MONEY

BULLDOG ENTERPRISE CO.

Like to Travel—Does Romantic, Wealthy South America call you? Unusual opportunities for young men. American employers. Fare and expenses furnished. BIG PAY. Write for Free List. SOUTH AMERICAN SERVICE BUREAU 14499 Alton Avenue, Detroit, Michigan

Is Man Pygmy or Giant?

(Continued from page 127)

molecules have to "stand on each other's shoulders" to reach across.

And molecules are the giants of this sub-visible world. Each is a universe in itself in which as many as 25,000 suns and satellites whirl at once. Within the molecules are the atoms and within the atoms are the electrons.

Look at this "o". It is so small that it disappears if you move the page a few feet away. Yet, science tells you that crammed within that "o" are a jostling crowd of atoms greater in number than all the stars you can see in the sky!

An article in the July issue of *POPULAR SCIENCE MONTHLY* told of a discovery announced by Robert A. Millikan, the American physicist who was awarded the Nobel Prize for his work with cosmic rays. He said recent tests led him to suspect that all space is filled with cosmic rays creating fresh atoms. For a long time, we have been told that the earth is wearing away and will eventually disappear. Dr. Millikan's idea that new atoms replace those lost through radioactivity suggests that the earth may last forever.

But even smaller than the atoms are the electrons, little planets that wheel on their orbits at speeds greater than that with which the earth circles the sun.

Imagine that everything around you suddenly begins to swell. The cats and cups and tables and buildings and the earth double, triple, quadruple in size.

THEY keep on until everything is ten billion times as big as it is now. Men would be ten million miles tall. And they would wheel around babies weighing fifty million tons. Mice would have tails so long that they could wrap them about the present equator a dozen times. A bird-shot would have swelled to the size of the earth as we know it.

But, even in such a fantastically magnified world, one of these electrons would have become no larger than the head of a pin.

Looking at such things, how gigantic seems man!

When Charles the First was King of England, one of his bodyguards was a giant who was in the habit of carrying a dwarf around with him in his pocket. If you were asked which of those two, the dwarf or the giant, best symbolized man, what would you say?

We are undecided, looking at man physically, whether he is a pygmy or a giant. But, viewing him from the angle of the mind, our answer is more definite.

All through his history, he has been fighting forces stronger than he. The lightning, the storm at sea, wild beasts, disease—these have been his hereditary enemies. But by using his mind he has conquered.

In his laboratories he plays with lightning that carries three million volts. On his steamships he plows safely through waves a hundred feet high that drop thousands of tons of water crashing on the deck. His children go to the zoo and are amused by the caged remnants of the fierce beasts that once menaced their ancestors. And disease after disease he has strangled at its source.

MAN, the giant, looks over the rim of the globe and sees a friend half around the earth—by television. He crosses the ocean in a single step—by airplane. He strides across the land faster than the fleetest deer—by automobile.

By using his brain, man has become swifter than the deer, stronger than the elephant, more keen-sighted than the eagle. He has conquered the air, the land, the sea.

Mentally, he has become the giant of the earth.



YOU CAN CHOOSE IF YOU WILL

CHANCE governs the general trend of too many lives. By chance many people live in a certain place, attend a certain school, take the opportune job; they chance upon certain associates, books, and thoughts.

But by courage and determined effort they could choose oftentimes where to live, what to study and, to a large extent, what to accomplish.

Hundreds of thousands of ambitious people are studying at home in their leisure time. Increased earning capacity is the objective that many are attaining. But whether the attainment be greater efficiency in business, or a more interesting social life, or the real joy of developing a more cultured point of view, the studies that lead to these objectives are available, wherever one lives, through Columbia Home Study Courses. The range of subjects is wide.

COLUMBIA UNIVERSITY

Offers Home Study Courses of University Grade
in the following Subjects:

Accounting	Composition	Harmony
Algebra	Decorative	History
American Government	English	Italian
American History	Various Languages	Juvenile Story Writing
American Literature	Lyric Poetry	Latin
Applied Grammar	Drafting	Law
Arithmetic	Drama	Magazine Article Writing
Banking	Drawing and Painting	Marketing
Botanical Literature	Personnel	Mathematics
Biology	Evolutionary Geography	Personnel Administration
Botany	English	Philosophy
Boy Scouting	English Literature	Photoplay Composition
Business Administration	Essay Writing	Physics
Business English	European History	Psychology
Business Law	Fire Insurance	Psychology in Business
Business Mathematics	French	Public Speaking
Business Organization	Geometry	Religion
Chemistry	German	Secretarial Studies
Child Psychology	Government	Short Story Writing
Classics	Grammar	Slide Films
Contemporary Novel	Greek	Sociology
		Spanish, etc., etc.

THESE courses have been prepared by our instructors to meet the special requirements of study at home. While all basic material essential to the full understanding of each subject is fully covered, sufficient elasticity is allowed to permit adaptation to the individual needs of the student. Everyone who enrolls for a Columbia course is personally taught by a member of the University faculty. Special arrangements can be made for group study.

The University will send on request full information about these home study courses. A coupon is printed below for your convenience. If you care to write a letter briefly outlining your educational interests our instructors may be able to offer helpful suggestions. Mention subjects which are of interest to you, even if they are not listed here because additions to the courses offered are made from time to time.

HIGH SCHOOL AND COLLEGE PREPARATORY COURSES

COLUMBIA UNIVERSITY Home Study Department has prepared courses covering the equivalent of four years of High School study. This complete High School or College Preparatory training is available to those who can not undertake classroom work. We shall be glad to send you our special bulletin upon request.

COLUMBIA UNIVERSITY, University Extension—Home Study Department, New York, N. Y.
Please send me full information about Columbia University Home Study Courses. I am interested in the following subject: _____
Pop. Bul. 4-25

Name _____

Occupation _____

Street and Number _____

City _____

State _____

Freedom from a Small-Pay Job Come to New York the city of 100,000 jobs

ANY MAN who can read and write and use a pair of pliers can become an electrical expert and free himself forever from the long hours and drudgery of a small pay job.

And you can learn the BIG PAY profession of electricity right in New York City, the heart of the electrical world—the city of 100,000 jobs. At the same time you are learning the BIG PAY profession you can be enjoying the sights and wonders of New York, the modern Bagdad.

Be an Electrical Expert

Graduates of the NEW YORK ELECTRICAL SCHOOL are in demand by all the big electrical companies. Or, if you prefer the independence of a business of your own, there are thousands of opportunities for efficient, dependable men to become electrical contractors. When you are your own boss the money you can make is limited only by your own energy and ability.

Personal Instruction

The NEW YORK ELECTRICAL SCHOOL is not a correspondence school. You learn by doing—by personal instruction on full size standard electrical equipment under the personal supervision of trained instructors.

At N. Y. E. S. you train your hands and mind as the same time. You learn the theories of electricity and then you are shown how to put the theories into actual practice by solving the problems with your own hands.

The man who has learned electricity by actually doing electrical work under intelligent personal instruction can go to any part of the world and be sure of a good living. There are N. Y. E. S. graduates in all the countries of the world.

Write today for the 44-page booklet giving full information about the N. Y. E. S. course and showing pictures of the equipment available for your personal use in our two-story building.

The NEW YORK ELECTRICAL SCHOOL
40 W. 17th Street, New York

MAIL TODAY

THE NEW YORK ELECTRICAL SCHOOL
40 W. 17th Street, New York.

Please send me FREE your 44-page booklet. It is understood that this request puts me under no obligation.

Name

Address

Here Are Correct Answers To Questions on Page 73

1. In 1859 there was drilled at Titusville, in northwestern Pennsylvania, the first producing oil well in the United States. From the oil of this well the first kerosene was made. The "rock oil," as it then was called, soon became the general illuminant of the country.

2. In ruins of the famous temple of the sun god, built by the Roman emperor Antonius Pius, at Baalbek, in Syria. The ruins can still be seen a few miles east of the modern city of Beirut. Some of the great stone blocks are more than sixty feet long by nearly twenty feet square.

3. The Great Barrier Reef is a long fringe of coral reefs on the northern coast of Australia. It is the longest in the world.

4. Such socks are worn with the native Japanese footwear which is provided with a string to go between the big toe and the other four.

5. In South Africa there lives a curious kind of fish called the "mudfish." When the rivers dry up in summer, the mudfish make themselves little nests in the mud and simply wait there until the river is full of water again. You can dig up the clods of mud containing the live fish.

6. The only places are the salt desert regions where the dry ground is saturated with salt or soda. In the United States the only such region of any size is the Great Salt Lake Desert, west and southwest of Great Salt Lake in Utah.

7. Most of the first-quality asbestos comes from Canada, near Black Lake, about sixty miles south of the city of Quebec. Small quantities of asbestos have been found in many other places in the world.

8. This name has been applied for generations to the city of Bucharest, capital of Rumania, formerly a province of the Roman Empire, from which its name is derived. The site of Bucharest was originally occupied by the Romans. Its fabric resembles to Paris is no doubt based upon its showy avenues and boulevards.

9. Nothing at all. This is merely an accidental similarity of the two names. Cocoa is a chocolate product from the seeds of the cacao plant. The main source of the coconut is in the East Indies, whereas the chief supply of cacao comes from the West Indies.

10. Geologists believe that the great Andes Mountain chain on the western coast of South America probably is the youngest mountain range. This is indicated not only by the general geological character of western South America, but also by the great height and steepness of these mountains. Older mountains have had time to be worn down.

11. These famous people belong to the San Blas tribe of Indians, living in Panama on the South American side of the Canal Zone. Some individuals in this tribe are almost white. The "white Indians" are really not a separate race, but are a variety of albinos, belonging to the ordinary native race of the region.

12. This distinction is believed to belong to Panama City, at the Pacific end of the Panama Canal. This city was founded by the Spaniards in 1519.

NIGHTS OF JOY IN STORE FOR YOU

START TO PLAY VERY FIRST DAY



Even if you can't read a note of music right now, you play a simple melody on the very day you get your Deagan Xyloimba. Free, easy lessons show you how. Soon you are making friends and relatives. Then a new life begins—long happy evenings of joy, parties, popularly, radio engagements and the same chance to make \$4 to \$8 a night as Ralph Smith, Chicago. Played 10 minutes at wedding, received \$20. Or the Halloway family (Reading, Pa.) made \$300 in 5 weeks, spare time.

FIVE DAYS' FREE TRIAL—Our big FREE book tells all about this fascinating instrument—the 5-day free trial offer the free lessons—the easy payment plan. Send in the coupon today; the booklet will be mailed promptly without cost or obligation.

MAIL COUPON TODAY!

J. C. Deagan, Inc., Dept. M54, 1775 Belmont Ave., Chicago

Send me, without obligation, full details of Free Trial offer and easy payment plan on the Deagan Xyloimba.

Name _____

Address _____

I'll Pay You \$30 a Day!

Show my Rain Proof FITS-U Cape to Man

Our liberal commission of \$1.00 on every sale is a profit in itself up to \$3.00 or more on every sale. Also, in one hour, we can show you how to make \$30 a day.

FREE **Booklet**

Don't Wait—Act Now!

Write to J. C. Deagan, Inc., Dept. M54, 1775 Belmont Ave., Chicago

LAW

STUDY AT HOME

Learn a high pay legal profession with high pay in a short time. No law school, no law degree, no law license. No law school, no law degree, no law license. No law school, no law degree, no law license.

FREE **Booklet**

Don't Wait—Act Now!

Write to J. C. Deagan, Inc., Dept. M54, 1775 Belmont Ave., Chicago

FREE to BOYS

Winnit Club, 29

120 Broadway St.,

Open Room for Boys

Practical, Man.

PAID SIGNERS

earn \$50 to \$200 WEEKLY

John Tamm, R. T. gets \$25 for plain show card. Crawford, R. T. gets \$100 for plain show card. Crawford, R. T. gets \$100 for plain show card.

DETROIT SCHOOL OF LETTERING

120 Hudson Ave. Est. 1890 DETROIT, MICH.

How to Work with Tools and Wood

This book explains in a simple, straightforward manner all the processes of working with tools and wood. It takes all the mystery out of working with tools and shows you the simple, easy, interesting and profitable ways to work with tools and wood.

Price \$1.00

POPULAR SCIENCE MONTHLY

200 Fourth Avenue New York City

New Magic Worked by Cameras

(Continued from page 128)

Chemical Society some of the hundred thousand photographs he has taken, showing the tracks of helium atoms or particles made visible by their microscopic trails of water vapor. Thirty of the photographs, he said, had caught the actual event of an atomic collision—a fascinating event that throws light on the atom's real structure.

Meanwhile Dr. Carl E. Searshore, of the University of Iowa, has discovered that all music and speech, since it can be reduced to a mere mechanical pattern of waves in the air, can be recorded and analyzed by photography, and he has devised a motion picture apparatus to record singing ability in terms of cold, impersonal charts of the singer's voice.

Another contributor to the unusual uses of photography is Dr. Walter B. Adams, of the Mount Wilson Observatory at Pasadena, Calif. By taking pictures of Mars and other planets by red, yellow, green, violet, and ultra-violet light in turn, he has made important new studies of their atmospheres and temperatures.

MOST important of all photography's uses, however, is its ability to see more accurately than the human eye—and to preserve an indelible record of what it sees. That is why every industry and every science, as well as many a law court, calls upon the camera for its unfailing record. Go to any great corporation, any factory or industrial concern, and you will find drawers upon drawers of photographs that have recorded for all time everything from the building of a dam to the forging of a bolt. And science esteems the camera as highly as industry.

Astronomers in this modern age need hardly ever look into the barrel of a telescope. In photographs they have records far more valuable than any observation made by eye (monotonous star charts of the sky are now replaced by the "patrol plates" of great observatories, detailed sets of photographs that survey the heavens at regular intervals and are kept on record forever).

NO LESS infallible is a novel type of instrument known as the factograph camera, recently developed for the speedy reading and recording of telephone meter figures. It is an ordinary camera into whose over-size hood has been built a bank of electric lamps run on dry batteries, supplying its own light. When its square nose is pressed against a meter the meter face is flooded with light and the film records a picture of the dial. Of course this camera has a host of other uses, for it can copy any document, signature, or paper against which it is pressed.

TAKING pictures of valuable gems, to identify them in case they are stolen, is a practice recently adopted by Paris jewelers that again makes use of the camera's unforgetting eye for detail. According to the National Jewelers' Association, it is expected that such photographs, revealing the most minute details of cut, size, coloring, and any imperfections, will instantly identify any stolen gem and make things unpleasant for the professional thief or fence.

Meanwhile, in America, a special camera has been designed to photograph on a single strip of motion picture film all the checks passing through a bank. The record thus obtained minimizes risk of fraud.

These are a few of the ways by which the camera, whose highest aim was once to take a picture of somebody's relative, has become a priceless servant of industry and science.

FREE

This Genuine
Ivorian
Pocket
Rule



Get out your pencil
and copy the jack
right now

—You get
this rule
for copying
this Jack—

Can you copy it? Try it. How you copy it may give me some idea of what kind of a draftsman you would be. If you are 16 years old or older and will mail me your sketch at once, I will send you, free and prepaid, a draftsman's ivory Pocket rule shown here.

This will go to you entirely with my compliments. In addition I will send you my book on Successful Draftsmanship. Don't wait. Copy the sketch now and mail it to me.

Draftsmen Needed In

Auto Work
The automobile is the most important part of the modern world. It is a machine that is constantly being improved. It is a machine that is constantly being improved. It is a machine that is constantly being improved.

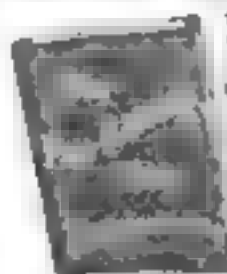
Electricity
Electricity is the most important part of the modern world. It is a machine that is constantly being improved. It is a machine that is constantly being improved. It is a machine that is constantly being improved.

Aviation
Aviation is the most important part of the modern world. It is a machine that is constantly being improved. It is a machine that is constantly being improved. It is a machine that is constantly being improved.

Motor Bus Work
Motor bus work is the most important part of the modern world. It is a machine that is constantly being improved. It is a machine that is constantly being improved. It is a machine that is constantly being improved.

Building Work
Building work is the most important part of the modern world. It is a machine that is constantly being improved. It is a machine that is constantly being improved. It is a machine that is constantly being improved.

Get My Free Pay-Raising Plan



Write to me. I will send you this new book. Not a catalog. My Pay-Raising Plan and Money Making Advisor. I can prove that John Davidson, trained by me, makes \$300 a month. A. J. Hupner, trained by me, makes \$500 a month. H. C. Hupner, trained by me, makes \$1,000 a month. A. H. Hupner, trained by me, makes \$1,500 a month. A. H. Hupner, trained by me, makes \$2,000 a month. A. H. Hupner, trained by me, makes \$2,500 a month. A. H. Hupner, trained by me, makes \$3,000 a month. A. H. Hupner, trained by me, makes \$3,500 a month. A. H. Hupner, trained by me, makes \$4,000 a month. A. H. Hupner, trained by me, makes \$4,500 a month. A. H. Hupner, trained by me, makes \$5,000 a month. A. H. Hupner, trained by me, makes \$5,500 a month. A. H. Hupner, trained by me, makes \$6,000 a month. A. H. Hupner, trained by me, makes \$6,500 a month. A. H. Hupner, trained by me, makes \$7,000 a month. A. H. Hupner, trained by me, makes \$7,500 a month. A. H. Hupner, trained by me, makes \$8,000 a month. A. H. Hupner, trained by me, makes \$8,500 a month. A. H. Hupner, trained by me, makes \$9,000 a month. A. H. Hupner, trained by me, makes \$9,500 a month. A. H. Hupner, trained by me, makes \$10,000 a month. A. H. Hupner, trained by me, makes \$10,500 a month. A. H. Hupner, trained by me, makes \$11,000 a month. A. H. Hupner, trained by me, makes \$11,500 a month. A. H. Hupner, trained by me, makes \$12,000 a month. A. H. Hupner, trained by me, makes \$12,500 a month. A. H. Hupner, trained by me, makes \$13,000 a month. A. H. Hupner, trained by me, makes \$13,500 a month. A. H. Hupner, trained by me, makes \$14,000 a month. A. H. Hupner, trained by me, makes \$14,500 a month. A. H. Hupner, trained by me, makes \$15,000 a month. A. H. Hupner, trained by me, makes \$15,500 a month. A. H. Hupner, trained by me, makes \$16,000 a month. A. H. Hupner, trained by me, makes \$16,500 a month. A. H. Hupner, trained by me, makes \$17,000 a month. A. H. Hupner, trained by me, makes \$17,500 a month. A. H. Hupner, trained by me, makes \$18,000 a month. A. H. Hupner, trained by me, makes \$18,500 a month. A. H. Hupner, trained by me, makes \$19,000 a month. A. H. Hupner, trained by me, makes \$19,500 a month. A. H. Hupner, trained by me, makes \$20,000 a month. A. H. Hupner, trained by me, makes \$20,500 a month. A. H. Hupner, trained by me, makes \$21,000 a month. A. H. Hupner, trained by me, makes \$21,500 a month. A. H. Hupner, trained by me, makes \$22,000 a month. A. H. Hupner, trained by me, makes \$22,500 a month. A. H. Hupner, trained by me, makes \$23,000 a month. A. H. Hupner, trained by me, makes \$23,500 a month. A. H. Hupner, trained by me, makes \$24,000 a month. A. H. Hupner, trained by me, makes \$24,500 a month. A. H. Hupner, trained by me, makes \$25,000 a month. A. H. Hupner, trained by me, makes \$25,500 a month. A. H. Hupner, trained by me, makes \$26,000 a month. A. H. Hupner, trained by me, makes \$26,500 a month. A. H. Hupner, trained by me, makes \$27,000 a month. A. H. Hupner, trained by me, makes \$27,500 a month. A. H. Hupner, trained by me, makes \$28,000 a month. A. H. Hupner, trained by me, makes \$28,500 a month. A. H. Hupner, trained by me, makes \$29,000 a month. A. H. Hupner, trained by me, makes \$29,500 a month. A. H. Hupner, trained by me, makes \$30,000 a month. A. H. Hupner, trained by me, makes \$30,500 a month. A. H. Hupner, trained by me, makes \$31,000 a month. A. H. Hupner, trained by me, makes \$31,500 a month. A. H. Hupner, trained by me, makes \$32,000 a month. A. H. Hupner, trained by me, makes \$32,500 a month. A. H. Hupner, trained by me, makes \$33,000 a month. A. H. Hupner, trained by me, makes \$33,500 a month. A. H. Hupner, trained by me, makes \$34,000 a month. A. H. Hupner, trained by me, makes \$34,500 a month. A. H. Hupner, trained by me, makes \$35,000 a month. A. H. Hupner, trained by me, makes \$35,500 a month. A. H. Hupner, trained by me, makes \$36,000 a month. A. H. Hupner, trained by me, makes \$36,500 a month. A. H. Hupner, trained by me, makes \$37,000 a month. A. H. Hupner, trained by me, makes \$37,500 a month. A. H. Hupner, trained by me, makes \$38,000 a month. A. H. Hupner, trained by me, makes \$38,500 a month. A. H. Hupner, trained by me, makes \$39,000 a month. A. H. Hupner, trained by me, makes \$39,500 a month. A. H. Hupner, trained by me, makes \$40,000 a month. A. H. Hupner, trained by me, makes \$40,500 a month. A. H. Hupner, trained by me, makes \$41,000 a month. A. H. Hupner, trained by me, makes \$41,500 a month. A. H. Hupner, trained by me, makes \$42,000 a month. A. H. Hupner, trained by me, makes \$42,500 a month. A. H. Hupner, trained by me, makes \$43,000 a month. A. H. Hupner, trained by me, makes \$43,500 a month. A. H. Hupner, trained by me, makes \$44,000 a month. A. H. Hupner, trained by me, makes \$44,500 a month. A. H. Hupner, trained by me, makes \$45,000 a month. A. H. Hupner, trained by me, makes \$45,500 a month. A. H. Hupner, trained by me, makes \$46,000 a month. A. H. Hupner, trained by me, makes \$46,500 a month. A. H. Hupner, trained by me, makes \$47,000 a month. A. H. Hupner, trained by me, makes \$47,500 a month. A. H. Hupner, trained by me, makes \$48,000 a month. A. H. Hupner, trained by me, makes \$48,500 a month. A. H. Hupner, trained by me, makes \$49,000 a month. A. H. Hupner, trained by me, makes \$49,500 a month. A. H. Hupner, trained by me, makes \$50,000 a month. A. H. Hupner, trained by me, makes \$50,500 a month. A. H. Hupner, trained by me, makes \$51,000 a month. A. H. Hupner, trained by me, makes \$51,500 a month. A. H. Hupner, trained by me, makes \$52,000 a month. A. H. Hupner, trained by me, makes \$52,500 a month. A. H. Hupner, trained by me, makes \$53,000 a month. A. H. Hupner, trained by me, makes \$53,500 a month. A. H. Hupner, trained by me, makes \$54,000 a month. A. H. Hupner, trained by me, makes \$54,500 a month. A. H. Hupner, trained by me, makes \$55,000 a month. A. H. Hupner, trained by me, makes \$55,500 a month. A. H. Hupner, trained by me, makes \$56,000 a month. A. H. Hupner, trained by me, makes \$56,500 a month. A. H. Hupner, trained by me, makes \$57,000 a month. A. H. Hupner, trained by me, makes \$57,500 a month. A. H. Hupner, trained by me, makes \$58,000 a month. A. H. Hupner, trained by me, makes \$58,500 a month. A. H. Hupner, trained by me, makes \$59,000 a month. A. H. Hupner, trained by me, makes \$59,500 a month. A. H. Hupner, trained by me, makes \$60,000 a month. A. H. Hupner, trained by me, makes \$60,500 a month. A. H. Hupner, trained by me, makes \$61,000 a month. A. H. Hupner, trained by me, makes \$61,500 a month. A. H. Hupner, trained by me, makes \$62,000 a month. A. H. Hupner, trained by me, makes \$62,500 a month. A. H. Hupner, trained by me, makes \$63,000 a month. A. H. Hupner, trained by me, makes \$63,500 a month. A. H. Hupner, trained by me, makes \$64,000 a month. A. H. Hupner, trained by me, makes \$64,500 a month. A. H. Hupner, trained by me, makes \$65,000 a month. A. H. Hupner, trained by me, makes \$65,500 a month. A. H. Hupner, trained by me, makes \$66,000 a month. A. H. Hupner, trained by me, makes \$66,500 a month. A. H. Hupner, trained by me, makes \$67,000 a month. A. H. Hupner, trained by me, makes \$67,500 a month. A. H. Hupner, trained by me, makes \$68,000 a month. A. H. Hupner, trained by me, makes \$68,500 a month. A. H. Hupner, trained by me, makes \$69,000 a month. A. H. Hupner, trained by me, makes \$69,500 a month. A. H. Hupner, trained by me, makes \$70,000 a month. A. H. Hupner, trained by me, makes \$70,500 a month. A. H. Hupner, trained by me, makes \$71,000 a month. A. H. Hupner, trained by me, makes \$71,500 a month. A. H. Hupner, trained by me, makes \$72,000 a month. A. H. Hupner, trained by me, makes \$72,500 a month. A. H. Hupner, trained by me, makes \$73,000 a month. A. H. Hupner, trained by me, makes \$73,500 a month. A. H. Hupner, trained by me, makes \$74,000 a month. A. H. Hupner, trained by me, makes \$74,500 a month. A. H. Hupner, trained by me, makes \$75,000 a month. A. H. Hupner, trained by me, makes \$75,500 a month. A. H. Hupner, trained by me, makes \$76,000 a month. A. H. Hupner, trained by me, makes \$76,500 a month. A. H. Hupner, trained by me, makes \$77,000 a month. A. H. Hupner, trained by me, makes \$77,500 a month. A. H. Hupner, trained by me, makes \$78,000 a month. A. H. Hupner, trained by me, makes \$78,500 a month. A. H. Hupner, trained by me, makes \$79,000 a month. A. H. Hupner, trained by me, makes \$79,500 a month. A. H. Hupner, trained by me, makes \$80,000 a month. A. H. Hupner, trained by me, makes \$80,500 a month. A. H. Hupner, trained by me, makes \$81,000 a month. A. H. Hupner, trained by me, makes \$81,500 a month. A. H. Hupner, trained by me, makes \$82,000 a month. A. H. Hupner, trained by me, makes \$82,500 a month. A. H. Hupner, trained by me, makes \$83,000 a month. A. H. Hupner, trained by me, makes \$83,500 a month. A. H. Hupner, trained by me, makes \$84,000 a month. A. H. Hupner, trained by me, makes \$84,500 a month. A. H. Hupner, trained by me, makes \$85,000 a month. A. H. Hupner, trained by me, makes \$85,500 a month. A. H. Hupner, trained by me, makes \$86,000 a month. A. H. Hupner, trained by me, makes \$86,500 a month. A. H. Hupner, trained by me, makes \$87,000 a month. A. H. Hupner, trained by me, makes \$87,500 a month. A. H. Hupner, trained by me, makes \$88,000 a month. A. H. Hupner, trained by me, makes \$88,500 a month. A. H. Hupner, trained by me, makes \$89,000 a month. A. H. Hupner, trained by me, makes \$89,500 a month. A. H. Hupner, trained by me, makes \$90,000 a month. A. H. Hupner, trained by me, makes \$90,500 a month. A. H. Hupner, trained by me, makes \$91,000 a month. A. H. Hupner, trained by me, makes \$91,500 a month. A. H. Hupner, trained by me, makes \$92,000 a month. A. H. Hupner, trained by me, makes \$92,500 a month. A. H. Hupner, trained by me, makes \$93,000 a month. A. H. Hupner, trained by me, makes \$93,500 a month. A. H. Hupner, trained by me, makes \$94,000 a month. A. H. Hupner, trained by me, makes \$94,500 a month. A. H. Hupner, trained by me, makes \$95,000 a month. A. H. Hupner, trained by me, makes \$95,500 a month. A. H. Hupner, trained by me, makes \$96,000 a month. A. H. Hupner, trained by me, makes \$96,500 a month. A. H. Hupner, trained by me, makes \$97,000 a month. A. H. Hupner, trained by me, makes \$97,500 a month. A. H. Hupner, trained by me, makes \$98,000 a month. A. H. Hupner, trained by me, makes \$98,500 a month. A. H. Hupner, trained by me, makes \$99,000 a month. A. H. Hupner, trained by me, makes \$99,500 a month. A. H. Hupner, trained by me, makes \$100,000 a month. A. H. Hupner, trained by me, makes \$100,500 a month. A. H. Hupner, trained by me, makes \$101,000 a month. A. H. Hupner, trained by me, makes \$101,500 a month. A. H. Hupner, trained by me, makes \$102,000 a month. A. H. Hupner, trained by me, makes \$102,500 a month. A. H. Hupner, trained by me, makes \$103,000 a month. A. H. Hupner, trained by me, makes \$103,500 a month. A. H. Hupner, trained by me, makes \$104,000 a month. A. H. Hupner, trained by me, makes \$104,500 a month. A. H. Hupner, trained by me, makes \$105,000 a month. A. H. Hupner, trained by me, makes \$105,500 a month. A. H. Hupner, trained by me, makes \$106,000 a month. A. H. Hupner, trained by me, makes \$106,500 a month. A. H. Hupner, trained by me, makes \$107,000 a month. A. H. Hupner, trained by me, makes \$107,500 a month. A. H. Hupner, trained by me, makes \$108,000 a month. A. H. Hupner, trained by me, makes \$108,500 a month. A. H. Hupner, trained by me, makes \$109,000 a month. A. H. Hupner, trained by me, makes \$109,500 a month. A. H. Hupner, trained by me, makes \$110,000 a month. A. H. Hupner, trained by me, makes \$110,500 a month. A. H. Hupner, trained by me, makes \$111,000 a month. A. H. Hupner, trained by me, makes \$111,500 a month. A. H. Hupner, trained by me, makes \$112,000 a month. A. H. Hupner, trained by me, makes \$112,500 a month. A. H. Hupner, trained by me, makes \$113,000 a month. A. H. Hupner, trained by me, makes \$113,500 a month. A. H. Hupner, trained by me, makes \$114,000 a month. A. H. Hupner, trained by me, makes \$114,500 a month. A. H. Hupner, trained by me, makes \$115,000 a month. A. H. Hupner, trained by me, makes \$115,500 a month. A. H. Hupner, trained by me, makes \$116,000 a month. A. H. Hupner, trained by me, makes \$116,500 a month. A. H. Hupner, trained by me, makes \$117,000 a month. A. H. Hupner, trained by me, makes \$117,500 a month. A. H. Hupner, trained by me, makes \$118,000 a month. A. H. Hupner, trained by me, makes \$118,500 a month. A. H. Hupner, trained by me, makes \$119,000 a month. A. H. Hupner, trained by me, makes \$119,500 a month. A. H. Hupner, trained by me, makes \$120,000 a month. A. H. Hupner, trained by me, makes \$120,500 a month. A. H. Hupner, trained by me, makes \$121,000 a month. A. H. Hupner, trained by me, makes \$121,500 a month. A. H. Hupner, trained by me, makes \$122,000 a month. A. H. Hupner, trained by me, makes \$122,500 a month. A. H. Hupner, trained by me, makes \$123,000 a month. A. H. Hupner, trained by me, makes \$123,500 a month. A. H. Hupner, trained by me, makes \$124,000 a month. A. H. Hupner, trained by me, makes \$124,500 a month. A. H. Hupner, trained by me, makes \$125,000 a month. A. H. Hupner, trained by me, makes \$125,500 a month. A. H. Hupner, trained by me, makes \$126,000 a month. A. H. Hupner, trained by me, makes \$126,500 a month. A. H. Hupner, trained by me, makes \$127,000 a month. A. H. Hupner, trained by me, makes \$127,500 a month. A. H. Hupner, trained by me, makes \$128,000 a month. A. H. Hupner, trained by me, makes \$128,500 a month. A. H. Hupner, trained by me, makes \$129,000 a month. A. H. Hupner, trained by me, makes \$129,500 a month. A. H. Hupner, trained by me, makes \$130,000 a month. A. H. Hupner, trained by me, makes \$130,500 a month. A. H. Hupner, trained by me, makes \$131,000 a month. A. H. Hupner, trained by me, makes \$131,500 a month. A. H. Hupner, trained by me, makes \$132,000 a month. A. H. Hupner, trained by me, makes \$132,500 a month. A. H. Hupner, trained by me, makes \$133,000 a month. A. H. Hupner, trained by me, makes \$133,500 a month. A. H. Hupner, trained by me, makes \$134,000 a month. A. H. Hupner, trained by me, makes \$134,500 a month. A. H. Hupner, trained by me, makes \$135,000 a month. A. H. Hupner, trained by me, makes \$135,500 a month. A. H. Hupner, trained by me, makes \$136,000 a month. A. H. Hupner, trained by me, makes \$136,500 a month. A. H. Hupner, trained by me, makes \$137,000 a month. A. H. Hupner, trained by me, makes \$137,500 a month. A. H. Hupner, trained by me, makes \$138,000 a month. A. H. Hupner, trained by me, makes \$138,500 a month. A. H. Hupner, trained by me, makes \$139,000 a month. A. H. Hupner, trained by me, makes \$139,500 a month. A. H. Hupner, trained by me, makes \$140,000 a month. A. H. Hupner, trained by me, makes \$140,500 a month. A. H. Hupner, trained by me, makes \$141,000 a month. A. H. Hupner, trained by me, makes \$141,500 a month. A. H. Hupner, trained by me, makes \$142,000 a month. A. H. Hupner, trained by me, makes \$142,500 a month. A. H. Hupner, trained by me, makes \$143,000 a month. A. H. Hupner, trained by me, makes \$143,500 a month. A. H. Hupner, trained by me, makes \$144,000 a month. A. H. Hupner, trained by me, makes \$144,500 a month. A. H. Hupner, trained by me, makes \$145,000 a month. A. H. Hupner, trained by me, makes \$145,500 a month. A. H. Hupner, trained by me, makes \$146,000 a month. A. H. Hupner, trained by me, makes \$146,500 a month. A. H. Hupner, trained by me, makes \$147,000 a month. A. H. Hupner, trained by me, makes \$147,500 a month. A. H. Hupner, trained by me, makes \$148,000 a month. A. H. Hupner, trained by me, makes \$148,500 a month. A. H. Hupner, trained by me, makes \$149,000 a month. A. H. Hupner, trained by me, makes \$149,500 a month. A. H. Hupner, trained by me, makes \$150,000 a month. A. H. Hupner, trained by me, makes \$150,500 a month. A. H. Hupner, trained by me, makes \$151,000 a month. A. H. Hupner, trained by me, makes \$151,500 a month. A. H. Hupner, trained by me, makes \$152,000 a month. A. H. Hupner, trained by me, makes \$152,500 a month. A. H. Hupner, trained by me, makes \$153,000 a month. A. H. Hupner, trained by me, makes \$153,500 a month. A. H. Hupner, trained by me, makes \$154,000 a month. A. H. Hupner, trained by me, makes \$154,500 a month. A. H. Hupner, trained by me, makes \$155,000 a month. A. H. Hupner, trained by me, makes \$155,500 a month. A. H. Hupner, trained by me, makes \$156,000 a month. A. H. Hupner, trained by me, makes \$156,500 a month. A. H. Hupner, trained by me, makes \$157,000 a month. A. H. Hupner, trained by me, makes \$157,500 a month. A. H. Hupner, trained by me, makes \$158,000 a month. A. H. Hupner, trained by me, makes \$158,500 a month. A. H. Hupner, trained by me, makes \$159,000 a month. A. H. Hupner, trained by me, makes \$159,500 a month. A. H. Hupner, trained by me, makes \$160,000 a month. A. H. Hupner, trained by me, makes \$160,500 a month. A. H. Hupner, trained by me, makes \$161,000 a month. A. H. Hupner, trained by me, makes \$161,500 a month. A. H. Hupner, trained by me, makes \$162,000 a month. A. H. Hupner, trained by me, makes \$162,500 a month. A. H. Hupner, trained by me, makes \$163,000 a month. A. H. Hupner, trained by me, makes \$163,500 a month. A. H. Hupner, trained by me, makes \$164,000 a month. A. H. Hupner, trained by me, makes \$164,500 a month. A. H. Hupner, trained by me, makes \$165,000 a month. A. H. Hupner, trained by me, makes \$165,500 a month. A. H. Hupner, trained by me, makes \$166,000 a month. A. H. Hupner, trained by me, makes \$166,500 a month. A. H. Hupner, trained by me, makes \$167,000 a month. A. H. Hupner, trained by me, makes \$167,500 a month. A. H. Hupner, trained by me, makes \$168,000 a month. A. H. Hupner, trained by me, makes \$168,500 a month. A. H. Hupner, trained by me, makes \$169,000 a month. A. H. Hupner, trained by me, makes \$169,500 a month. A. H. Hupner, trained by me, makes \$170,000 a month. A. H. Hupner, trained by me, makes \$170,500 a month. A. H. Hupner, trained by me, makes \$171,000 a month. A. H. Hupner, trained by me, makes \$171,500 a month. A. H. Hupner, trained by me, makes \$172,000 a month. A. H. Hupner, trained by me, makes \$172,500 a month. A. H. Hupner, trained by me, makes \$173,000 a month. A. H. Hupner, trained by me, makes \$173,500 a month. A. H. Hupner, trained by me, makes \$174,000 a month. A. H. Hupner, trained by me, makes \$174,500 a month. A. H. Hupner, trained by me, makes \$175,000 a month. A. H. Hupner, trained by me, makes \$175,500 a month. A. H. Hupner, trained by me, makes \$176,000 a month. A. H. Hupner, trained by me, makes \$176,500 a month. A. H. Hupner, trained by me, makes \$177,000 a month. A. H. Hupner, trained by me, makes \$177,500 a month. A. H. Hupner, trained by me, makes \$178,000 a month. A. H. Hupner, trained by me, makes \$178,500 a month. A. H. Hupner, trained by me, makes \$179,000 a month. A. H. Hupner, trained by me, makes \$179,500 a month. A. H. Hupner, trained by me, makes \$180,000 a month. A. H. Hupner, trained by me, makes \$180,500 a month. A. H. Hupner, trained by me, makes \$181,000 a month. A. H. Hupner, trained by me, makes \$181,500 a month. A. H. Hupner, trained by me, makes \$182,000 a month. A. H. Hupner, trained by me, makes \$182,500 a month. A. H. Hupner, trained by me, makes \$183,000 a month. A. H. Hupner, trained by me, makes \$183,500 a month. A. H. Hupner, trained by me, makes \$184,000 a month. A. H. Hupner, trained by me, makes \$184,500 a month. A. H. Hupner, trained by me, makes \$185,000 a month. A. H. Hupner, trained by me, makes \$185,500 a month. A. H. Hupner, trained by me, makes \$186,000 a month. A. H. Hupner, trained by me, makes \$186,500 a month. A. H. Hupner, trained by me, makes \$187,000 a month. A. H. Hupner, trained by me, makes \$187,500 a month. A. H. Hupner, trained by me, makes \$188,000 a month. A. H. Hupner, trained by me, makes \$188,500 a month. A. H. Hupner, trained by me, makes \$189,000 a month. A. H. Hupner, trained by me, makes \$189,500 a month. A. H. Hupner, trained by me, makes \$190,000 a month. A. H. Hupner, trained by me, makes \$190,500 a month. A. H. Hupner, trained by me, makes \$191,000 a month. A. H. Hupner, trained by me, makes \$191,500 a month. A. H. Hupner, trained by me, makes \$192,000 a month. A. H. Hupner, trained by me, makes \$192,500 a month. A. H. Hupner, trained by me, makes \$193,000 a month. A. H. Hupner, trained by me, makes \$193,500 a month. A. H. Hupner, trained by me, makes \$194,000 a month. A. H. Hupner, trained by me, makes \$194,500 a month. A. H. Hupner, trained by me, makes \$195,000 a month. A. H. Hupner, trained by me, makes \$195,500 a month. A. H. Hupner, trained by me, makes \$196,000 a month. A. H. Hupner, trained by me, makes \$196,500 a month. A. H. Hupner, trained by me, makes \$197,000 a month. A. H. Hupner, trained by me, makes \$197,500 a month. A. H. Hupner, trained by me, makes \$198,000 a month. A. H. Hupner, trained by me, makes \$198,500 a month. A. H. Hupner, trained by me, makes \$199,000 a month. A. H. Hupner, trained by me, makes \$199,500 a month. A. H. Hupner, trained by me, makes \$200,000 a month. A. H. Hupner, trained by me, makes \$200,500 a month. A. H. Hupner, trained by me, makes \$201,000 a month. A. H. Hupner, trained by me, makes \$201,500 a month. A. H. Hupner, trained by me, makes \$202,000 a month. A. H. Hupner, trained by me, makes \$202,500 a month. A. H. Hupner, trained by me, makes \$203,000 a month. A. H. Hupner, trained by me, makes \$203,500 a month. A. H. Hupner, trained by me, makes \$204,000 a month. A. H. Hupner, trained by me, makes \$204,500 a month. A. H. Hupner, trained by me, makes \$205,000 a month. A. H. Hupner, trained by me, makes \$205,500 a month. A. H. Hupner, trained by me, makes \$206,000 a month. A. H. Hupner, trained by me, makes \$206,500 a month. A. H. Hupner, trained by me, makes \$207,000 a month. A. H. Hupner, trained by me, makes \$207,500 a month. A. H. Hupner, trained by me, makes \$208,000 a month. A. H. Hupner, trained by me, makes \$208,500 a month. A. H. Hupner, trained by me, makes \$209,000 a month. A. H. Hupner, trained by me, makes \$209,500 a month. A. H. Hupner, trained by me, makes \$210,000 a month. A. H. Hupner, trained by me, makes \$210,500 a month. A. H. Hupner, trained by me, makes \$211,000 a month. A. H. Hupner, trained by me, makes \$211,500 a month. A. H. Hupner, trained by me, makes \$212,000 a month. A. H. Hupner, trained by me, makes \$212,500 a month. A. H. Hupner, trained by me, makes \$213,000 a month. A. H. Hupner, trained by me, makes \$213,500 a month. A. H. Hupner, trained by me, makes \$214,000 a month. A. H. Hupner, trained by me, makes \$214,500 a month. A. H. Hupner, trained by me, makes \$215,000 a month. A. H. Hupner, trained by me, makes \$215,500 a month. A. H



The Game for Daring Young Men



ARE you a red-blooded, daring be-man? Do you crave adventure, popularity, admiration, and the applause of great crowds? Then why not get into the Aviation Industry—the greatest adventure since time began—the greatest thrill ever offered to man?

Think what Aviation offers you. The probe and bleed of the multitude. And a chance to get in on the ground floor where rewards may be unlimited! Aviation is growing so rapidly that one can hardly keep track of all the astonishing new developments. Air-mail routes have just been extended to form a vast aerial network over the entire U. S. Many Commercial Airlines and airplane factories are now being organized. Men like Henry Ford are investing millions in the future of commercial Aviation for they see its great possibilities.

Easy to Get Into Aviation By This Home Study Method

Get into this thrilling profession at once while the field is new and un-crowded. Now—by a unique new plan—you can quickly secure the home and preparatory training at home, in spare time. Experts will teach you the secrets and fundamentals of Practical Aviation—give you all the inside facts that are essential to your success. And, the study of Aviation by this remarkable method is almost as fascinating as the actual work itself.

Send for FREE Book!

Send coupon for our new free book. Get out—opportunities in the Airplane Industry. This is an interesting, profitable business and tells you things about this amazing profession you never even dreamed of. Write for your copy today.

AMERICAN SCHOOL OF AVIATION
3044 Michigan Ave., Dept. 1246 Chicago

AMERICAN SCHOOL OF AVIATION
3044 Michigan Ave., Dept. 1246 Chicago, Ill.
Without obligation, please send me your FREE book, "Opportunities in the Airplane Industry." You will also receive about your Home Study Course in Practical Aviation.

Name _____ Age _____

Address _____

City _____ State _____

DICK BYRD—Adventurer

(Continued from page 39)

may strike the public as being less colorful. This new work is the series of side flights Byrd will make east and west of his route to the Pole itself. Already Scott and Amundsen have traversed this route afoot. But the tiny "perch" they cut from the unknown continent leaves vast areas on either side which Byrd will see for the first time by air.

Suppose the entire surface of the United States had never before been seen. What an adventure it would be to traverse it before any other human being! The Antarctic continent permits just this alluring possibility to Byrd, save that it is mostly snow-buried and may contain no form of animal life.

Yet there is always the enticing thought that there may be wide areas that are not under ice and snow. Witness Peary's experience in 1897, when he stepped down off the Greenland ice-cap on almost the very shores of the Polar Sea and found an extensive land totally bare of ice and snow, filled with flowers and inhabited by musk-oxen and Arctic hares. He even found distinct traces of human habitation.

THE scientists with Byrd know that he may find new species of animals, active volcanoes, precious minerals, strange phenomena new to human knowledge, and a score of other fascinating possibilities. Indeed, it stirs the blood of any man to contemplate this last great geographical secret succumbing to the bold enterprise of an American aviator.

The cost of the expedition will be in the neighborhood of \$750,000. It will be the largest and most splendidly equipped ever sent to polar regions. Every iota of past experience, native ingenuity and man's inventive genius will go not only into the scientific equipment but into such items as the clothing, food, housing, and mechanics of the party.

It is not easy for the average man to picture Byrd's life on the Antarctic plateau. He will live in a temperature averaging a hundred degrees colder than at home. He will eat pemmican and blubber. He will wear clothing of skins. He will move for nearly four months in darkness and for an equal number of months in perpetual sunlight. The other months will be lit by a curious steady twilight peculiar to the Antarctic regions.

HE WILL keep alive, as though it were a throbbing human heart, one of the finest short-wave radio sets that have ever been put together. His installation is of no standard make. It is being designed and built with the assistance of the best brains in the United States Navy, the United States Department of Commerce, the United States Bureau of Standards, and several large commercial manufacturers of radio equipment.

Its cost will be somewhere near \$25,000. It will require antenna height of less than 100 feet, and yet have a radius of operation of over 14,000 miles. Byrd expects to talk daily with New York, sending through a brief word picture of his life that the American people may follow comfortably the exciting sortics he will make into the unknown.

Remember that the seasons south are reversed. Thus on a scorching July day next summer when we wretches are gasping for a breath of air we may expect to read in our daily paper:

"As sun now gone two months, we are in complete darkness. Temperature at headquarters seventy-one degrees below zero. Wind steady-four miles per hour. Drifting snow. All well Byrd."

Two groups of his party will not find such conditions very trying. These are his dogs and Eskimos.

My greatest problem will be to get them south," he laughed the other day. "Guess I'll have to put both" (Continued on page 141)

Be An Auto Expert!

LEARN in LOS ANGELES

TRAINED MEN NEEDED Earn \$40 and up a week. If you are earning less this is your chance to get into the Auto Industry. We pay you more and offer greater opportunity. You qualify for Big Pay Job through National Automobile School. California is Land of Opportunity. Millions being spent on autos here. Learn Mechanics, Ignition, Repairs, Construction, Garage Management, Etc. Qualify for technical or executive position or go into business for yourself. **ENTER NOW** No Age Limit Low Tuition. 12th Year Unexcelled Training. Thirty-two instructors. Free employment service while learning and after graduation. Write for Illustrated Catalog. **FREE** Tell everything.

NATIONAL AUTOMOTIVE SCHOOL

DEPT. 303, 4004 Figueroa St. Los Angeles, Calif.
Send me the big FREE National Auto Book that explains how I can succeed in the Automobile Industry.
Name _____
Address _____
City _____



Watch Chain FREE! For this. **DOWN**
We are offering a beautiful Watch Chain. This special offer will be sent to persons who write at once. Don't delay! Get this free chain off your watch within 10 days.
STURBAKER WATCH COMPANY
Incorporated by the Watchmakers' Franchise System, Inc.
3000-3001 North Broadway, Chicago, Ill.
Dept. V 900 South Bond, Indiana
Catalogue Address: Sturba, Ind.

You and This New Machine Can Earn \$500 a Month
Operate a Tire Repair Shop. Make up to \$500 a month. America's greatest opportunity for those with small capital. We furnish everything. Low and up. Easy payment. We train you FREE high at home. Start making money at once. Write today for Free Book of Opportunity.
HAYWOOD TIRE EQUIPMENT CO.
2121 W. Ogden Ave. Chicago, Illinois

DRAW CARTOONS
Turn Your Talent Into Money. Cartoons are from \$50 to \$250.00 per week. Some even more. Draw a new "Tide" system of drawing teaches you a half the usual time. Good for booklets and sample books. Plate explaining full details of the course.
THE NATIONAL SCHOOL OF CARTOONING
2121 Broadway, Cleveland, Ohio



DICK BYRD—Adventurer

on the ice while we are crossing the equator!" But he was serious enough. Remember that the Eskimo dog as well as the native of the far north is accustomed to a temperature range of thirty-five degrees above zero to eighty degrees below. The dog perspires through his mouth and sleeps out of doors even in the coldest weather. The native wears loose skin clothing and can sleep in the open sitting behind a wind-break when the thermometer is in the minus fifties.

Further, both dog and man are used to an exclusively meat diet. They can digest and assimilate masses of only flesh, mostly raw. To follow such a diet in the tropics would not do well yet to shift to vegetables or other lighter foods might be fatal.

I traveled for several years with Nukarpungwah, one of the Greenland Eskimos Byrd hopes to take with him. This hunter is about four feet seven inches tall and weighs less than one hundred and thirty pounds. He is stockily built, has never had a bath, and prefers raw meat to cooked. The only food he eats regularly besides meat is raw elder duck eggs.

"You see, Byrd reminded me, he will not realize that we are going to the southern end of the globe. He'll think he is back home when he sees the ice and snow again. Then where will I be when he asks about the Polar bears and walrus?"

IN THIS connection Byrd has carefully studied all types of sledges. He will need strong ones if only to carry the 100 tons of seal flesh which he must collect in the Bay of Whales for his dogs.

The sledge Byrd has decided on will be nearly the same as Amundsen's. He will not need an Eskimo sledge because he will not travel on sea ice; and he must have wide flat runners to ride over the deep snow of the South Polar glaciers. Hence his favor for the Norwegian type which weighs less than thirty pounds, as compared with Peary's rugged 100-pound framework built to withstand the chaotic pressure flows in the far north.

To supplement the dogs in hauling loads he is taking two 100-ton tractors. These will help hoist his heavy cargo from the ship's boats up on to the ice barrier. They will also haul loads of provisions to depots near the headquarters, from which the dogs will in turn haul smaller loads to other depots farther away. Lines of depots about 100 miles apart will radiate in several directions from the base.

"I wish we'd had a tractor in Spitzbergen!" exclaimed husky Tom Mulroy to me as I was writing this piece. "It took every ounce of strength the crew could muster to get our big plane up the snow bank for its take-off."

This gives another important duty for the tractors. They will no doubt be used to drag the ponderous Ford tri-motored plane up the icy glacier's face behind the base in order that it may find a run long enough to get up and away from the Pole.

There will also be a large Fairchild plane for long wide trips in search of new land, and a smaller plane for reconnaissance or rescue work. The Ford, at least, will have a radioable under proper conditions to reach the base.

One unique part of the plane equipment will be automatic cameras pointing downward that will permit Byrd to bring back an accurate photographic record of the new territory over which he will pass. Thus for the first time in history an explorer will bring back a visible record of vast discoveries.

If he can do this, besides planting the Stars and Stripes at the Pole, and making a thorough scientific scrutiny of the land he finds, he believes his expedition will have been worth many times the money, effort, and travail that it costs.

PATENTS INVENTORS



Write for these
FREE BOOKS!

At the left is a view of my drafting and specification office where a large staff of experienced men is in my constant employ. All drawings and specifications are prepared under my personal supervision.

Protect Your Ideas Take the First Step Today

If you have a useful practical, novel idea for any new article or for an improvement on an old one, you should communicate with a competent Registered Patent Attorney AT ONCE. Every year thousands of applications for patents are filed in the U. S. Patent Office. Frequently two or more applications are made for the same or substantially the same idea even though the inventors may live in different sections of the country and be entirely unknown to one another. In such a case, the burden of proof rests upon the last application filed. Delays of even a few days in filing the application sometimes mean the loss of a patent. So lose no time. Get in touch with me at once by mailing the coupon below.

Strict Secrecy Preserved—Write Me in Confidence

All communications, sketches, drawings, etc., are held in strictest confidence in strong steel fireproof files, which are accessible only to authorized members of my staff. Feel free to write me fully and frankly. Your case will have my personal attention. It is probable that I can help you. Highest references. Not FIRST clip the coupon and get my free book. Do THAT right now.

Prompt—Careful Efficient Service

This large, experienced organization devotes its entire time and attention to patent and trademark cases. Our offices are directly across the street from the U. S. Patent Office. We understand the technicalities of patent law. We know the rules and requirements of the Patent Office. We can proceed in the quickest, safest and best way in preparing an application for a patent covering your idea. Our success has been built on the strength of careful efficiency, satisfactory service to inventors and trademark owners located in every state in the Union.

No Charges for Information on How to Proceed

The booklet shown here contains valuable information relating to patent procedure that every inventor should have. And with it I will send you my "Record of Invention" form, on which you can sketch your idea and establish its date before a witness. Such evidence may later prove valuable to you. Simply mail the coupon, and I will send you the booklet and the "Record of Invention" form, together with detailed information as to how to proceed and the costs involved. Do this NOW. No need to lose a minute's time. The coupon will bring you complete information entirely without charge or obligation.

Mail this Coupon Now!

Clarence A. O'Brien
Registered Patent Attorney

221 Security Savings & Com. Bank Bldg.,
Washington, D. C.

Please send me your free book, "How to Obtain a Patent" and your "Record of Invention" form without any cost or obligation on my part.

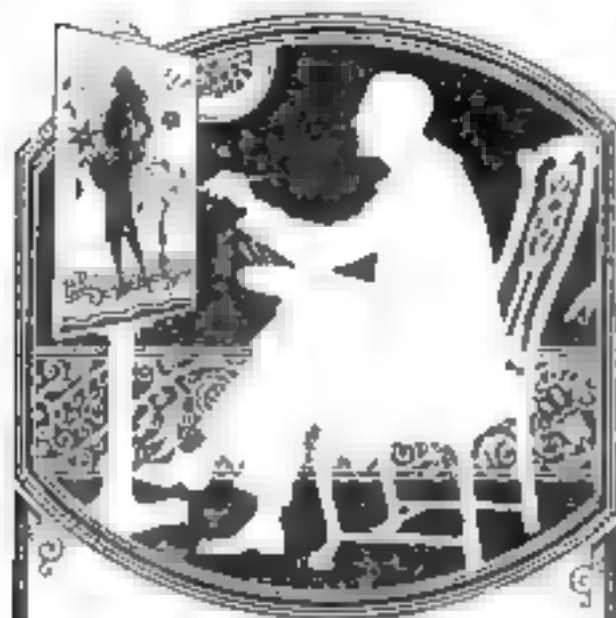
Name _____

Address _____

(Important: Print or Write name clearly)

Clarence A. O'Brien
Registered Patent Attorney

Member of Bar of Supreme Court of the United States; Court of Appeals, District of Columbia; Supreme Court, District of Columbia; United States Court of Claims.
Practice confined exclusively to Patents, Trademarks, and Copyrights



Let us test your ART ability-FREE

HERE is your opportunity to find out how much talent you have. A simple scientifically prepared questionnaire tests your natural sense of design, proportion, color, perspective, etc. indicating whether it will be worth while to develop your ability to draw, and showing how much training will be needed. You will be fully informed as to what your score shows. This analysis may show you the way to a bigger future—a real career.

Federal Students Are Successful

Many Federal School students are making \$1,000, \$4,000, \$6,000 and \$8,000 yearly. The Federal School is recognized everywhere by employers of art work, and by buyers of artwork. Its pupils are paid for drawings and designs, for they are a necessity in modern business.

Learn Commercial Art at Home

If you like to draw, an illustration or indication of talent, the Federal Course will soon prepare you to earn a handsome income. Some students earn more than the cost of the course while studying. Many nationally known artists have contributed exclusive illustrated lessons to the Federal Course, which has been prepared to train the student in the quickest possible time. No previous training is needed. You will receive personal, individual criticism on your work.

Send TODAY for Your Questionnaire!

Just fill out and mail the coupon, stating age and occupation. There is no cost or obligation to you. We will also send back YOUR FUTURE, explaining the course and showing work of Federal Students.

Federal School
of Commercial Designing

1159 Federal School Bldg.,
Minneapolis, Minn.

Send for your analysis questionnaire without cost or obligation.

Name _____
Age _____ Present Occupation _____
Address _____

Do You Know How Your Icebox Is Built?

(Continued from page 53.)

box in Photograph 4 is of very poor construction as far as insulation is concerned, although in appearance it ranks with the others. This box, as the illustration shows, was cut in two, revealing that the heat insulation consisted of nothing but a one-inch air space and two skimpy layers of felt. At 90°, this box maintained an average inside temperature of about 64°. Even in the coldest part of the box, directly under the ice chamber, the temperature was 36°.

THESE tests, made with the boxes filled with ice, the doors unopened, and conditions as favorable as possible for the iceboxes, proved improper insulation even before the boxes were ripped open.

It doesn't take much imagination to picture the sort of food preservation you would get with still cheaper boxes, kept only partly filled with ice, especially with the doors opened as frequently as in normal use.

The iceboxes tested are in no sense "horrible examples." They are as good iceboxes as can be obtained at the prices. Investigation of insulation is necessary in selecting a good refrigerator.

If you are considering the purchase of a new refrigerator, write to the Popular Science Institute of Standards for the latest edition of the booklet, "Refrigeration for the Home." It contains information on various types of refrigerators, important points to keep in mind when buying, and directions for proper care. The price of the booklet is twenty-five cents. A list of tested and approved refrigerators will be included. Address your letters: Popular Science Institute of Standards, 230 Fourth Avenue, New York.

Great Oceans Under the Ground

FEW people stop to realize that the ground under their feet is full of flowing streams and rivers. Yet, according to the latest estimates of Dr. Chester A. Reeds, of the American Museum of Natural History, the water under the ground is equal in volume to one third of all in the oceans.

This water, says Doctor Reeds, has been gathering in the ground for ages. In some places it probably goes down to a depth of six miles. Tricking through the rocks, it forms subterranean waterway systems, such as are found in the Mammoth Cave in Kentucky and the Endless Caverns in Virginia.

Lakes which have their outlets in hidden streams are more or less common. In the Snake River Basin in Idaho, a river flows beneath volcanic rocks. And below Shoshone Falls, in the same region, underground water bubbles forth in beautiful springs at the rate of more than three billion gallons a day.

Meteors Cause Imitation Quakes

SOME weeks ago a giant meteor flashed like a bombshell across the skies above Georgia and South Carolina. Startled inhabitants reported a severe accompanying "earthquake." Houses trembled, window panes crashed.

Can meteors cause earthquakes?

An answer was supplied by Prof. Charles P. Olivier, of the University of Virginia, president of the American Meteor Society. "No," he said. But the air waves stirred up when a meteor plunges through the earth's atmosphere can shake buildings with their force. And the effects are almost exactly like those of an earthquake. A meteor, he said, may travel as fast as twenty-five miles a second—fifty times the speed of a shell from a big gun.

PATENTS

TO THE MAN WITH AN IDEA

PATENTS Protected. Trade Marks Registered. A comprehensive experienced prompt service by the presentation and development of your ideas. Preliminary advice given. Published a high class. Booklet of information and forms for developing ideas from on request.

IRVING L. McCATHRAN

PATENT LAWYER

Formerly with and successor to
Richard B. Owen

201 Duane Building, Washington, D. C.
41-D, Park Row New York City

TRADE MARKS REGISTERED



\$300,000 FOR THIS INVENTION

That's what I getman Kodak paid for the Automatic film. I developed of other inventions are needed and offer numerous opportunities for earning income. If you are of all inventive turn of mind why not develop your own things that are really

NEEDS: Get Raymond Vester's new book
"1000 Needed Inventions"

Costs only \$3.25 and may start you thinking along the right lines. You'll get nowhere in your own mind. Consider what the future has in store and what the public want. A lot of ideas are told you what things are needed on things that are needed. I'll tell you \$1.25 plus \$2.00 when back a \$3.25. You must look for you want it. This offer limited. Write now and get on the right track. Inside L. V. 41 25 Park Row New York City.

Department of Inventive Sciences
Dept. 10 Winner Building Rochester, N. Y.

INVENTORS

who derive large sums of money from their inventions. Write LACEY & LACEY, 440 9 St., Washington, D. C. Established 1895.

PATENTS

Trade-marks, Copyrights, Patent Litigation, Handbook with illustrations, 100 mechanical movements. Sent free on request.

ALBERT E. DIETERICH

Formerly member Spanning Corp. & Patent Office
Patent Lawyer and Solicitor

27 years' experience
881-A Courcy Bldg. Washington, D. C.

PATENTS

BOOKLET FREE PROMPTNESS ASSURED HONESTY REFERENCES BEST RESULTS

Send drawing or model for examination
And advice

WAYSON E. COLEMAN, Patent Lawyer
724 North Street Washington, D. C.

INVENTORS

Send details of your invention to the patent office. Write for information to inventors. Address: Atlanta, Ga. 514 1/2 N. 1st St. Knight St. Louis, Mo.

Book on Law Free

Write today for this new book. It tells you how a law training will shorten your road to success. It also carries a vital and inspiring message to every ambitious man. Find out about the opportunities that await the law-trained man. Find out how you can learn law right in your own home. The book is absolutely FREE. Write Today—your future is in law. American Correspondence School of Law 3001 Michigan Ave. Dept. 1388 Chicago, Ill.

What Good Is Automobile Insurance?

(Continued from page 69)

company is bound to pay the other fellow's damages assessed against you or agreed upon. Your steering knuckle breaks and your machine crashes through a plate glass window, for which the company must pay.

But suppose you smash your new car into your old one inside the garage, no liability. Or suppose you are taking home an expensive radio set which is damaged in a collision.

Here's what the policy says:

"The company assumes legal liability for the injury to or destruction of the property of other persons, but excluding the property of the assured, or in charge of the assured, or any of his employees, or carried in or upon the automobile of the insured."

Suppose some friend, thinking to play a joke, appropriates your car for a "joy ride" and has a crash. The company is not liable.

THE coverage holds good while the insured car is being operated by any persons with your permission, or with the permission of any adult member of your household, other than a chauffeur or domestic servant. But

"The indemnity extended to persons other than the assured shall not apply if the automobile is being used as a public automobile, or is owned or operated by any automobile manufacturer, dealer, garage, repair shop, or service station, unless the laws of the state in which this policy is issued provide to the contrary."

Keep that in mind the next time you ask the garage man to drive your car home. If he should smash it up, or kill or injure somebody—!

Members of your family may sue you, under your personal liability insurance, and recover in the courts for any injuries received while riding with you in your car. Recently a mother, as "next friend" to their minor child, sued her husband and recovered \$1,000 damages, which the insurance company had to pay. The boy had been severely cut when his father drove into a parked machine.

Perhaps it is well enough known (but it should be remembered) that if your car is being driven by anyone under the legal age limit, or in any event under sixteen years of age, the insurance company may disclaim all liability.

Your insurance is automatically canceled when your car is being driven "in any race or speed contest," whether on a race track or speedway or not.

IF YOUR car is being operated "in any illicit or prohibited trade or transportation" and something happens to it, the insurance company can revoke the policy completely.

Be careful and accurate in your statements when you are applying for insurance, for a clause specifies that "misrepresentation of any material fact or circumstance" relieves the insurance company of all liability.

The policy specifically relieves the company from payment of any damages "caused directly or indirectly by invasion, insurrection, riot, civil war, or commotion military, naval, or usurped power, or by order of any civil authority."

A few weeks ago a policeman commandeered a passing automobile and directed the driver to pursue two fleeing robbers. The machine crashed into another car, wrecking both, and hit a lamp-post. The company refused to pay, holding that the damage was caused "indirectly by order of a civil authority."

Cleaning Glue Off a Workbench

SPRINKLE wet sawdust on a cabinetmaker's bench encrusted with glue. When the sawdust is removed after twelve hours the glue comes with it.

PATENTS TRADE-MARKS AND COPYRIGHTS



OUR OFFER: FOR THE PROTECTION OF YOUR INVENTION YOUR FIRST STEP. The inventor should write for our blank form—"RECORD OF INVENTION." This should be signed, witnessed, and returned to us, together with model or sketch and description of the invention for INSPECTION and ADVICE FREE!

Our FIVE Books Mailed Free to Inventors

Our Illustrated Guide Book
HOW TO OBTAIN A PATENT
Contains full instructions regarding U. S. Patents, Our Methods, Terms, and 100 Mechanical Movements illustrated and described.

OUR TRADE-MARK BOOK
Shows value and necessity of Trade-Mark Protection. Information regarding Trade-Marks and unfair competition in trade;

OUR FOREIGN BOOK
We have Direct Agencies in Foreign Countries and secure Foreign Patents in shortest time and at lowest cost.

PROGRESS OF INVENTION
Description of World's Most Pressing Problems by Leading Scientists and Inventors. All Communications and Data Strictly Confidential. Interference and Infringement Suits Prosecuted.

DELAYS ARE DANGEROUS IN PATENT MATTERS IMPORTANT! To Avoid Delay!

YOU SHOULD HAVE YOUR CASE MADE SPECIAL IN OUR OFFICE to save correspondence, secure protection and early filing date in the Patent Office. To secure special preparation of your case send \$25.00 on account with model or sketch and description of invention.

Our Lawyers Practice in all U. S. Courts and defend Clients in Suits Involving Patents, Trade-Marks and Copyrights

OUR ORGANIZATION OFFERS PERSONAL SERVICE
By Experienced Patent Lawyers, Solicitors, and Draftsmen
We regard a satisfied client as our best advertisement, and furnish, upon request, lists of clients in any state for whom we have secured patents.

Highest References—Prompt Service—Reasonable Terms

WRITE TODAY

FREE COUPON **VICTOR J. EVANS & CO.**

Registered Patent Attorneys

MAIN OFFICES: 690 Ninth St., Washington, D. C.

BRANCH OFFICES: 1007 Woolworth Bldg., New York City; 518-519 Liberty Bldg., Philadelphia, Pa.; 514 Empire Bldg., Pittsburgh, Pa.; 1114 Tacoma Bldg., Chicago, Ill.; 1010 Hobart Bldg., San Francisco, Calif.

Gentlemen Please send me FREE OF CHARGE your books as described above.

Name

Address

DOUBLE PROFITS



\$544.00 IN A MONTH



Here's something startlingly new! A revolutionary "Twin" plan of selling that pays men everywhere double profits. So read the Free Test Offer below. Then act.

ONE of the most sensational chapters in the history of direct selling has been written in the past 4 months. For, almost incredible as it may sound, in that short time over 2000 men have discovered the secret of double profits on 4 out of 5 sales.

Twin Inventions Needed Everywhere

This unique plan is made possible by two revolutionary patented inventions. A new kind of can opener, absolutely automatic, holds the can, cuts the top out (not off) inside the rim, leaving it smooth, slick and clean—all in a couple of seconds at the turn of a crank—ends forever all stabbing and hacking with old-style can openers. A twin invention, an equally revolutionary knife, scissors and tool sharpener—operating on new, patented "major groove" principle—sharpens automatically at a twist of the wrist.

Every home feels an instant need for at least one of these amazing new devices. Four out of five buy both because of unique interchangeable feature, both operate in same key way bracket. There is no room for all the sensational details here. Our plan includes practical sales training courses. We furnish everything. Exclusive territories. Write today for Free Test Offer and proof of \$408 to \$144 a week.

\$544.00
FIRST MONTH

Send us 14 stamps. Here's the result of my 7th month's work. June 11-30. Orders: 1000. Sales: 1000. Profit: 1000. Total: 3000. Write today for Free Test Offer and proof of \$408 to \$144 a week.

CENTRAL STATES MFG. CO.

(Established over 20 years)

Dept. L-342 4348 Mary Ave. St. Louis, Mo.

Central States Mfg. Co. Dept. L-342
4348 Mary Ave., St. Louis, Mo.

Rush me details of your double profit plan and Free Test Offer

Name

Address

Town

State

Jerry Smashes Through

(Continued from page 145)

trying to buy his Drumwell-National stock."

The tool dresser grinned.

"Somebody thinks we're going to get there, do they?"

"Well, I don't know," Jerry opened the letter and read "I know several others who have also been approached, but nobody was offered more than about fifteen cents on the dollar. This fellow claims that the well cannot be successful, because it is still blocked and it is being drilled crooked. I thought I would write and ask you what you think."

"Fifteen cents doesn't seem like much of a price, does it?" Medford mused. "What you telling him?"

"I'm writing him to hold his stock."

"Sounds to me like good advice."

"And I'm suggesting that he tell his friends to hold theirs."

IN DRUMWELL, the vague reports of progress at the well were followed with interest, dampened somewhat by the earlier failures of the six wells in the same territory, but nevertheless alert for what might prove the opening of a new pool comparable to the one to the south. The pumping of the walking-beam and the run of the bailer were discussed in post office, bank, cafe and store.

"They're still drilling up there."

"What they going to do about that crooked hole?"

"Oh, Jerry Crandall knows what he's doing."

Day after day the same topics were reviewed. Then there was a flash of real news for the community.

Jerry had come racing down Broadway and skidded to a stop in front of the Gidley-Smith supply house. He had packed out two fishing tools, loaded them into his car, and gone speeding back. Now it was reported that an extra cable had been delivered to the well a week before.

Further details became known. The hole had been drilled around the end of the lost tool, virtually undermining them. They had slid downward on top of the working tools and pinned them in. But now they were loose in the hole and could be reached.

Furdy Vincent Bolton was surprised. His soft fingers fluttered among the papers on his polished desk.

"What do you think of that?" he exclaimed.

HE WALKED to the door and back, and the floor creaked under his huge bulk. A couple of young fellows were loafing in the office, talking of the developments. He went one to call Crandall to him.

Notwithstanding the summons, it was the next morning when Jerry appeared at the office.

"Couldn't leave sooner," he explained.

"A very interesting situation, is it not?" the vice president commented, smiling.

Very, replied Jerry.

"I congratulate you upon the impending success you seem to be coming to. I confess that you have surprised me. And I want to cooperate in every possible way I can. I am engaging Mr. Norden to help you recover the tools from the well."

"They're already recovered. We got them out at 4 A.M."

The vice president's jaw dropped, and he grinned sheepishly.

"Did you—was—is everything all right?"

Jerry looked at him as if not knowing how to judge him.

"We're going to fill the crooked part with rock now, and drill it straight," he announced.

"Yes—yes, indeed. Of course," Bolton's first apparent confusion was vanishing. He spread his fingers on the desk. "I shall help you speed the progress. We shall start two shifts. Mr. Norden can start. (Continued on page 147)

450 Miles on a Gallon of Gas!

According to a recent article by the president of the world's largest motor power corporation, there is enough energy in a gallon of gasoline if converted 100% to mechanical energy to run a four cylinder car 450 miles.

NEW GAS SAVING INVENTION ASTONISHES CAR OWNERS

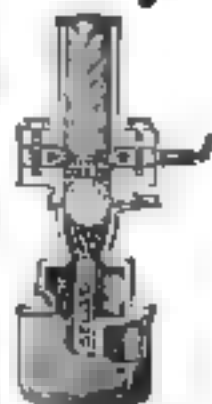
A marvelous device, already installed on thousands of cars, has accomplished wonders in utilizing a portion of the waste energy and in producing mileage tests that seem unbelievable. Not only does it save gasoline, but it also creates extra power gives instant starting, quick pick-up, and eliminates carbon.

FREE SAMPLE — \$100 a Week

To obtain business distribution quickly, men are being appointed everywhere to help supply the tremendous demand. Free samples furnished to workers. Write today to H. Miller, Inc. for this free sample and big money making offer.

WHIRLWIND MFG. CO.

909-314-E Third St., Milwaukee, Wis.



Make Money In Electricity

Learn in Los Angeles!

Be an electrician, a specialist, a journeyman, or a helper. Learn the trade in the heart of the industry. The National Electrical School is the only school in the country that teaches the trade in the heart of the industry.

Now you can learn the trade in the heart of the industry. The National Electrical School is the only school in the country that teaches the trade in the heart of the industry. You can learn the trade in the heart of the industry. The National Electrical School is the only school in the country that teaches the trade in the heart of the industry.

FREE BOOK

NATIONAL ELECTRICAL SCHOOL

Learn AVIATION WHERE LINDBERGH STARTED!

GET TRAINING

THAT ASSURES SUCCESS!

COME to the Lincoln Airplane School—where Lindbergh started. Get the same thorough, complete instruction—now under greatly increased facilities. Get your practical ground and flying training. You work on real planes and motors supplied by the Lincoln Aircraft Factory. You go right up into the sky in our famous Lincoln Page planes. (No profit, experienced instructors. Write at once for full information.)

LINCOLN AIRPLANE SCHOOL

Successors to the Lincoln Standard Aircraft School
2418 O Street, Lincoln, Nebraska


MAKE BIG MONEY SELLING PERSONAL CHRISTMAS GREETING CARDS


Original designs. Reasonable prices. Every prospect will buy. Cards sell at sight. Handsome Sample Book FREE. Large commission on all sales. Best value on the market. Write immediately. Rochester Art Co. Dept. I, Rochester, N. Y.







Giant Chest Expander and Progressive Exerciser





Send No Money Use This Money Saving Coupon

NOW IT IS EASIER

FREE INSTRUCTIONS

YOUR GUARANTEE

\$2

FOR 5 CABLES
\$4 FOR 10 CABLES
\$6 FOR 15 CABLES
\$8 FOR 20 CABLES

HOW TO ORDER—SEND NO MONEY

PROGRESSIVE EXHIBITION CO.,
6007 Lexington Bldg.
Broadway and Queens Street, New York.

Complete and	Your 12 copies	Your 12 copies	Progressive
	1 copy 12 copies	1 copy 12 copies	Exhibition
Check the following copy sent			
For information individuals please			
send if you can not otherwise			
your order to within 6 days and get your order back.			

Thank you very much for your order.

Very truly yours,

Progressive Exhibition Co.

If you live outside the United States send with order



Follow This Man!

Secret Service Operator 18 Is on the Job!

FOLLOW him through all the excitement of his chase of the counterfeit gang. See how a cry stops a rick. Tell the finger prints on the lamp stand in the murdered girl's room! The detective's cigarette case is handled by the unsuspecting gangster and a great mystery is solved. Better than fiction. It's true, every word of it. No exaggeration.

Free The Confidential Reports No. 38 Made to His Chief

And the best part of all is this It may seem good
 and in the green foliage of Tully's is highly probable
 "Plover" is a bird. The most are provided right
 here. The whole idea is to get you just like you and
 (possibly) in the high of the ground. This is the
 best of all. I would like to say full of similar
 birds. It is a bird. However.

WRITE and I'll send the Five Reports—also a wonderful illustration book. A King of the future waiting you as a Finger Print Expert.

University of Applied Science
1920 Sunnyside Ave., Dept. C-136 Chicago, IL

Jerry Smashes Through

1. *What is the main purpose of the study?*

now." Jerry detected a sly note in his voice.
"No, not Mr. Norden, please."

Jerry's gray eyes were cool, but little ripples were playing under his jaw. Bottom was rubbing his hands nervously.

"I hardly understand," he protested. "I don't grasp your meaning, young man."

"Norden was drilled when those tools fell into the well wasn't he?"

"Yes, yes. But an accident—you know that sort of thing."

"I'll tell you, Mr. Bolton. I feel a sort of responsibility in this. I talked the company into letting me go ahead with the well. If Norden comes back on the job, I'll quit."

"Yes. I realize. But I'd rather not talk about it, unless I have to quit. Of course if I quit, I'll explain why."

"OH, WE'D hate to lose your services," said Boston hastily. "There's no need for now just go ahead, and we'll forget about the Norden matter. You just go ahead and continue to operate as you have been doing."

"All right, Mr. Bolton. I think we're going to get something in that way."

The tools were pounding in the hole again, smashing their way straight ahead now. Jerry marked the program, feeling the cable and giving another turn to the temper-crew on the walking-beam to let the line lower, as the hungry bit at the end could bite further into the rock.

A fiercer sort of joy showed in his eyes as he took turns with the sledge, dressing the extra bit now dulled and battered from its work. His bare arms were flashes of sweating tan in the sun as he rained blows upon the glowing metal. Medford grinned in admiration as the hot steel took form, edged and true. It was a better job of tool dressing than he could do.

Both men turned to see Bolton smiling in at them. He stood with one immaculate boot raised to the drilling floor and a large pink hand resting on his knee.

"Yes, sir," he said. "That is the kind of thing I like to see. How are you programming?"

Pretty well, Jerry replied. "Of course it's a slow Limestone formation and now

Holton nodded understandingly. He stepped in upon the floor.

* A BEAUTIFUL job you're doing, though.

"It's a pity it isn't thoroughly appreciated." He shook his head, slowly and crinkled his rocky forehead. "You know some of the stockholders are getting quite pessimistic about expenses. Now if they could just see you working there, dressing that bit—" He smiled a moment, and then became serious again. "The trouble is, though, there doesn't seem to be much hope of finding oil. That is the way they feel, at any rate. And, confidentially, he lowered his voice out of earshot of Medford, who had gone to the other side—" confidentially, I am inclined to think the same. (1909)

"I'm betting there's oil here," Jerry asserted. "True, you can't ever be positive. But I do know the limestone we're drilling now is the same stuff as the caprock that lay like a lid right on top of a fortune in oil in the other field. If I'm a good guesser the gray slush we're bailing up now means Wilcox sand next. That may hold nothing but water, but then it may bring oil."

"Maybe so. Perhaps you're right. But the feeling among the stockholders is that there has been enough money spent. I'm afraid—I'm afraid we're going to have to shut down in a week or so, before we go as deep as we had intended."

* Really? Do you think so, Mr Bolton?"

(Craftsman on page 143)

Old Style Shaving Feels Like This



365 Keen Shaves With One Blade

Slick, velvety shaves forever and no more
rust blades on you! That's what you can
expect from Gillette's new, the steaming blade-
refresher! Means new blades out of old a
turning any—week after week, month after
month. Give them a sharpen they seldom
needed even when brand new! No wonder
people pronounce it one of the greatest inven-
tions ever put forth!

Special OFFER Now!
Right now to introduce
KIKIS KII AS a paper
which is over 44%
at 14.1 and giving with it
FREE a unique new kind
of paper. Really 3 ways to
one. Once adding no need of
polling stick. Reducers be
of course. 44% More for
de min. if special offer today.
No obligation. Just make the
switch. Be.


Rhodes KRIS-KROSS Stropper
RHODES MFG. CO., Dept. M-243
1418 Pandleton Ave., St. Louis, Mo.

RHODES MFG. CO., Dept. M-143
1416 Pendleton Ave. St. Louis, Mo.

W. boyr obligation please send me detailed explanation of N1134-51114 strapper which is for export to prices. Also tell me about 3-way factor too when without charge.

Name	
Address	
Town	State
<input type="checkbox"/> Check here if interested in becoming representative.	

Go to School at Home!



HIGH SCHOOL COURSE IN TWO YEARS

YOU ARE BADLY HANDICAPPED if you lack High School training.

You cannot attain business or social prominence. You are barred from a successful business career, from the leading professions, from well-paid civil service jobs, from teaching and college entrance. In fact, employers of practically all worth-while positions demand High School training. You can't hope to succeed in the face of this handicap. But you can remove it. Let the American School help you.

FIT YOURSELF FOR A BIG FUTURE

This course, which has been prepared by some of America's leading professors, will broaden your mind, and make you keen, alert and capable. It is complete, simplified and up-to-date. It covers all subjects given in a resident school and meets all requirements of a High School training. From the first lesson to the last you are carefully examined and coached.

USE SPARE TIME ONLY

Most people idle away fifty hours a week. Probably you do. Use only one-fifth of your wasted hours for study and you can remove your present handicap within two years. You will enjoy the lessons and the knowledge you will gain will well repay the time spent in study.

Check and mail the coupon NOW for full particulars and Free Bulletin.

American School

Dept. H-475,

Drexel Ave. and 18th St., Chicago

American School

Dept. H-475, Drexel Ave. & 18th St., Chicago
Send me full information on the subject checked and how you will help me win success.

- | | |
|-------------------------|--------------------------|
| Architect | Business Law |
| Building Contractor | Lawyer |
| Automobile Engineer | Mechanical Shop Practice |
| Automobile Mechanic | Mechanical Engineer |
| Civil Engineer | Shop Superintendent |
| Structural Engineer | Employment Manager |
| Business Manager | Personality |
| Cert. Public Accountant | Sanitary Engineer |
| Accountant and Auditor | Surveyor & Mapping |
| Bookkeeper | Telephone Engineer |
| Draftsman and Designer | Telegraph Engineer |
| Electrical Engineer | High School Graduation |
| Electric Light & Power | Wireless Radio |
| General Education | Undecided |
| Vocational Guidance | |

Name

Address

Jerry Smashes Through

(Continued from page 147)

"I'm afraid so. Disappointing, isn't it?"

"Darned disappointing!"

"Yes, I feel as you do. Inasmuch as we were making the attempt, I hoped we would be able to reach its completion."

He rose and turned to go, with a sorrowful shrug of his big shoulders. "I thought I'd tell you," he said. "If I were you, I wouldn't let that go—well, I don't think it would make much difference whether you did a little more or a little less the next few weeks. The way things appear now, it won't come to anything, anyway. When high speed is needed, I have a grateful appreciation for it, but I am the kind of man who doesn't believe in asking for unusual effort when it won't do any good. You understand?"

"Y-e-s," said Jerry slowly. "I understand, I think."

BUT the news of the impending shutdown did not slow his work. Rather it seemed to proceed more swiftly, with an almost desperate energy. The engine steamed and the bull-wheel whirled, winding the cable about it. Little sprays of mud shot off in the wind, as the line came up from the slush in the hole. The tools rose dripping and slick and were swung clear.

Medford brought the hailer from the side. The five-foot bucket dropped swiftly into the hole. Downward sped the mud line, almost a mile of it. A strip of cloth which Jerry had tied around it, marking the length, announced that the hailer was at the bottom.

When the whirling calf-wheel pulled it up and it was drawn aside to be emptied, Jerry bent close watch upon the muddy water sluicing out. All the pulped rock and earth, ground up by the bit, had to be brought up in that water. To his alert eyes, it was the story of the formations through which he was drilling. Fackula, moved from the outpourings of the hailer and left to settle, gave up dark gray silt. He rubbed it between his fingers, studying it intently.

The bit was pounding again. Some softer stratum yielded more easily now. The hailer brought up a slush of soft green shale. This was no common formation. Again Jerry compared his records. Sure enough, the same green shale had appeared at 4,000 feet in the field on the other side of Drumwell. Jerry grinned. The tools plunged deeper. There were brief intervals between the turns to the bumper screw, lowering the line below the walking-beam. The five feet of extension it allowed were let out quickly, and a new hold was taken on the cable, farther up. In a day they made thirty "screws"—a hundred and fifty feet of progress.

"SHUT us down, will they?" Jerry said through his teeth. "They'll have to hurry."

Medford laughed boyishly with excitement and pleasure.

"It won't be long now! We're going to know one way or the other. Anybody that wants to stop us will sure have to hustle."

In the parlor of his home in Oklahoma City, old Clarence Fittley sat talking with a stranger named Breen. Fittley had retired to enjoy middle age after a score of years as a merchant in several oil towns, including Drumwell. Breen's past and present were less obvious.

"What does it matter who I'm with?" Breen demanded. "I want to buy the lease from you in my own name. I'm talking cash."

"But the Drumwell-National is drilling on it," Fittley replied. "Even if I wanted to, I couldn't sell it while they're drilling."

Breen's lips moved a little to one side and downward as he laughed. "You ought to know more about oil leases than that. Listen here!" His harsh voice seemed (Continued on page 149)



Young outdoor men wanted

Interesting, vigorous outdoor work in a growing organization where merit wins advancement. Good starting wages. Permanent positions and a real future for men who make good. Our present field force of Davey Tree Experts cannot meet the increasing demand. So we are selecting now, to enter our employ, a few sturdy, clean young men, thorough Americans, single, between 20 and 30 years old, free to travel, industrious, with good practical education, and able to give good references. Write for qualification blank to serve in place of personal interview. The Davey Tree Experts Co., Inc., 131 Federal Bldg., Kent, Ohio.



Military Schools

Will it be a Military School for your boy, with its excellent training and helpful outdoor activities? If so, which of the many fine schools? To assist you in choosing, consult the School Directory of *Harper's Magazine*, a part of every issue.

Private schools, colleges and camps of unquestioned standing advertise in *Harper's Magazine* September issue out today. Write our School Bureau for helpful information and for free copy of Mrs. Blair's article, "Why I Sent My Children Away to School."

Harpers
MAGAZINE

40 East 33rd St., New York, N. Y.

"Experiments With 110-Volt Alternating Current"

HERE at last is a book that gives a practical knowledge of the alternating current. The only way to gain a thorough understanding of electricity is by direct personal experiment. How a practical knowledge of the alternating current can be gained in an interesting and inexpensive way is shown. The knowledge that comes from experiment is of vastly more value than that acquired from the performance of the stereotyped series of battery experiments usually described in books on Alternating Current.

The book "Experiments with 110-Volt Alternating Current" is needed by every man experimenting with alternating current.

256 pages, 135 illustrations.

Price, postpaid \$1.75

POPULAR SCIENCE MONTHLY
250 Fourth Avenue New York City

This One



UFOJ-24X-YNNG

Jerry Smashes Through

(Continued from page 140)

the road had the outlines of the coupe which had stood there briefly on that night when he had slept at the well.

Bleen was urging Bolton to leave the place. He threw his coat back, showing a folded paper in an inner pocket, and laughed his queer, one-sided laugh. What was the need of further argument? The lease would be theirs in three days. The driller did not suspect. The well would not be producing oil before that time.

But Bolton would not yield. Jerry's words about the filed cable had been disturbing. He came back, with a new strategy.

"Look here now, young man. I've always liked you." The old syrup was back in his voice. "You know, you've made some pretty serious remarks." He put his hand out toward the driller's arm. "I wish—"

"You see that cable?" Red anger flamed beneath Jerry's tan. He flung his finger toward the line descending into the well. "There's a strip of cloth around it marking a mile. When that cloth shows up, you'd better be gone from here, if you love your hide!"

The vice president glanced at the cable. It was speeding faster.

"See here, young fellow—"

He backed away. Jerry followed. Bolton turned and broke into a run. He jumped into the coupe, after Bleen.

"Hey! Look! Jerry! Look!"

Medford was yelling excitedly. He ducked under a timber of the derrick, jumped to the ground outside, and ran, looking back over his shoulder, and shouting.

"Look! Jerry!"

FOLLOWING Bolton in his anger, Jerry had let go the brake lever. The tools had gone smashing to the bottom of the hole. It was all that was needed.

There was a rumbling. A roar. A black column of liquid shot up, thundering like a suddenly freed Niagara. There was a crash, the sound of splintering wood, and the steel tools tore through the derrick timbers, a three-ton bullet shot through a mile-long gun.

Jerry stared, wide-eyed, as if stunned by the suddenness of the thing. Off to the side, Medford gaped for a moment, then leaped into the air, turned a handspring, and came dashing toward Jerry.

Medford clutched at Jerry's arms and shook him. In a moment the driller's tenseness snapped as he flung his own hat madly into the air and joined the tool-dresser in his antics of glee. They shook each other's hands, danced in a crazy circle, and let go their hoarse voices in unheard cheers.

From Main and Broadway, Drumwell, you could see the gusher, spouting out over the crown-block, giving off a feathery spray in the wind, a great black plume of oil announcing the discovery of a new pool and new millions in wealth, signaling the triumph of a driller who wouldn't be stopped.

Bolton and Bleen sat dejectedly in the office that night.

"I guess I'm done for with the Drumwell-National," said the vice president.

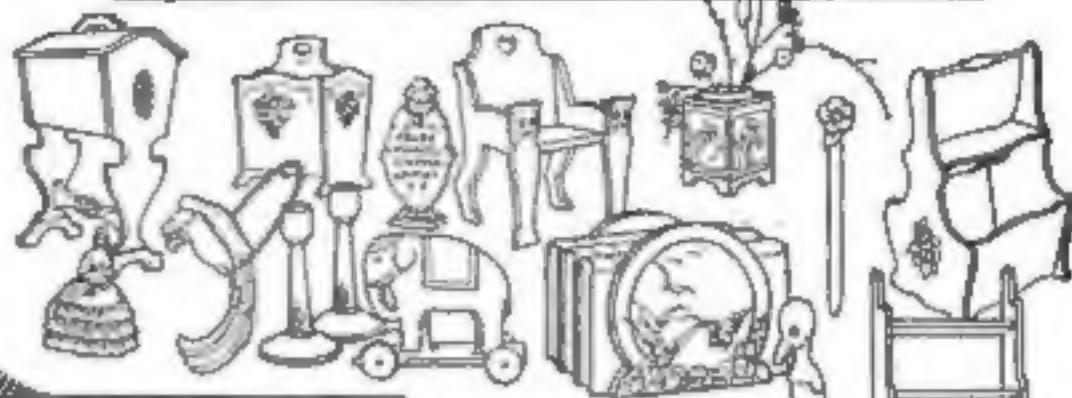
Bleen gave no sign of hearing. He took a folded paper from his pocket and crumpled it viciously, mumbling to himself.

"If they'd just been three days later!"

At the rig, Jerry was frowning, while a work crew plied picks and shovels throwing up earth embankments to hold the lake of oil till pipe-lines and tanks could be completed.

"I could kick myself!" he complained to Medford. "I shouldn't have lost my temper. Then we wouldn't have had this makeshift work." The pinch of conscience showed in his bright gray eyes. "We'd have saved the company this money, if I'd waited just a week to bring it in!"

WANT SOME MONEY?



Here's a wonderful way to get it

Our beautifully illustrated book tells how. It tells all about our new methods of art decoration, art treatment and how anybody can learn without previous training or experience. It contains page after page of handsome color illustrations of what you can make and sell. You can make good money and this book is

FREE

Our system is so simple, easy to learn and the profits are larger than in almost any other business. You can produce beautiful finished art objects almost from the beginning. You don't have to know how to draw or have any experience. Begin making money now. All supplies are sent by us with the instructions and many have made \$25 the first week. Some society women have taken up this work for their own amusement.

Either way, pleasure or profit, it's the most delightful home work you can imagine. Write now for your copy of this valuable book. It's FREE! Fireside Industries Dept. 31-M Adrian, Mich.

GOOD FOR PLAN

FIRESIDE INDUSTRIES,
Dept. 31-M, Adrian, Mich.

Gentlemen: Send me free book and complete plan for making money.

Name.....

Address.....

City.....State.....

Make \$12.00 A DAY by Showing PIONEER Tailoring

Double Your Income
Even part time men make \$12.00 per hour by selling famous PIONEER made-to-measure all-wool union-made suits at \$10.00 per suit. Liberal cash commission paid daily to salesmen. Customer gets perfect service. No stock required. We train the salesman. We supply the suits. All business expenses covered. Free work sheet and prospectus. Write today. Pioneer Tailoring Co. Congress and Thorne Dept. W1121, Chicago



25th Year

CHICAGO TECHNICAL COLLEGE

LEARN fundamentals of DRAFTING IN 4 MONTHS

Expert draftsmen earn \$40 to \$150 per week. Get into this profitable field after a Chicago Tech. fundamental short course. Couple this with practical experience and be a big-pay man. Many employment opportunities. Enter any time, day or evening. Athletics. Also 2-yr. diploma and 3-yr. B.S. Degree Courses in Engineering, Electricity, Architecture. Write for free 80-page "Blue Book."

Chicago Technical College

Dept. 24, 411 719 E. 26th St. Chicago



QUICK, EASY PROFITS!

Practically no investment. Small space required. Steady demand and BIG PROFITS re: Crocheting, Knitting, Furniture, painting, linens and more with this quick profit system. This man does the work of ten with brushes. Pays for itself on every monthly payment. 30 DAY TRIAL. Write today for details. ROBERT HUGHES CO. Box 1983, Troy, Ohio

Learn Cartooning

At Home—in Your Spare Time
The famous Picture Cart Method of teaching original drawing has opened the door of success for hundreds of beginners. Whether you think you have talent or not, send for sample chart to test your ability, and examples of the work of students earning from \$50 to \$200 per week. Please state your age. **THE LANDON SCHOOL** 1611 National Bldg., Cincinnati, O.



"On the Fast Mail in the Hudson River Valley"

Travel on "Uncle Sam's Payroll" \$158 TO \$225 MONTH

MAIL COUPON BEFORE YOU LOSE IT

Franklin Institute, Dept. F275, Rochester, N. Y.

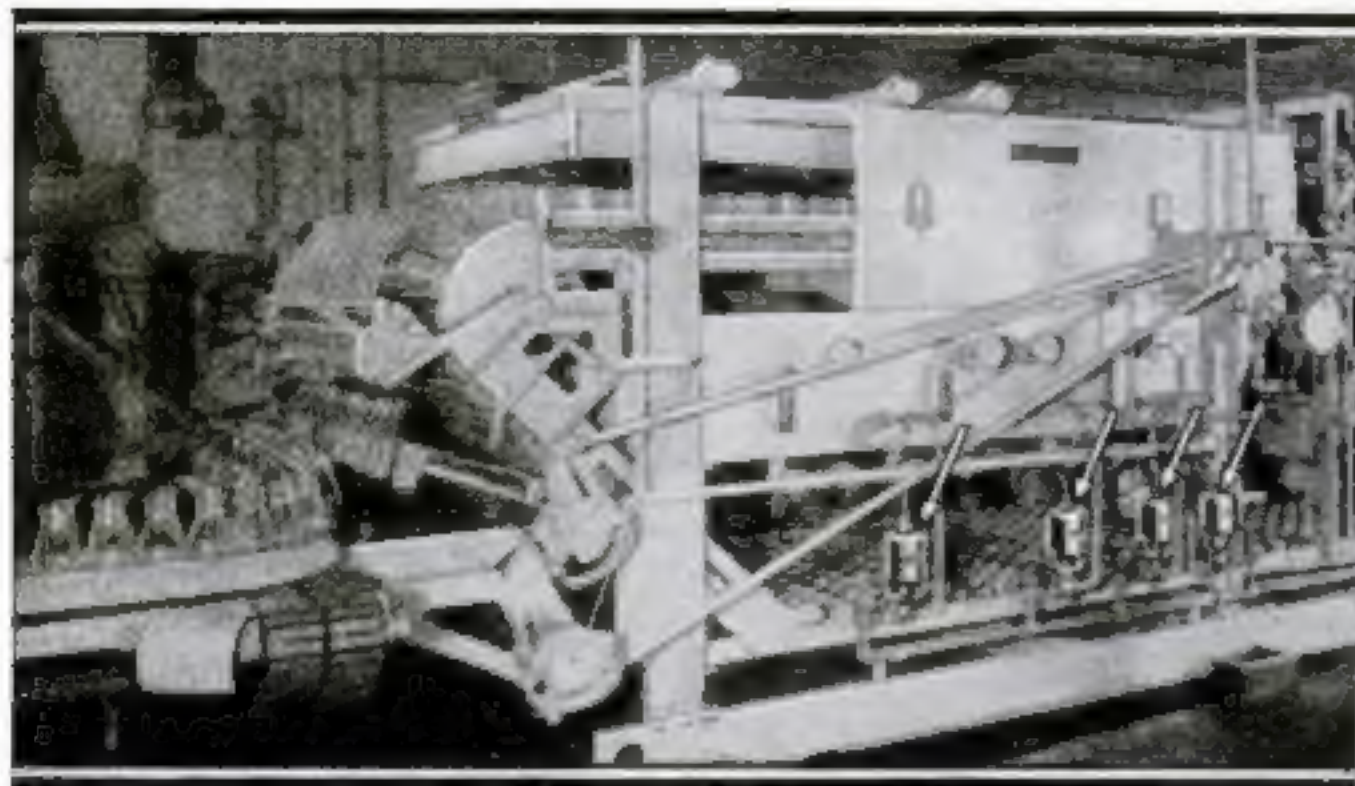
Give: Rush to me, without charge, (1) Full particulars telling how to become a Railway Postal Clerk; (2) actual copy of 22-page book, "How to Get U. S. Government Jobs," with list of many Government positions obtainable and complete coaching.

Name.....

Address.....

Study Work-At-Home-Paid Vacation-Common Education Solicited

Tycos - the Sixth Sense of Industry



Five Self-Acting Temperature Regulators installed on a bottle washer in a milk plant



That you and your children may live long and healthy lives

ONE of the big contributions to longer and healthier lives for you and your children is the care food manufacturers take in the preparation of foods that reach you in cans, jars and bottles.

And aiding manufacturers at every point where heat enters into the preparation of products for the market are *Tycos* Instruments for indicating, recording and controlling heat processes.

Take the milk industry for instance. The first step is to heat the milk to 142° to 145° and hold it there for thirty minutes. At less than 142° any germs of communicable diseases that might be present wouldn't be killed—at more than 145° the cream line is killed. This process depends entirely upon proper temperature control. This is absolutely controlled by using *Tycos* Single Duty Thermometers and *Tycos* Recording Thermometers says one of the largest creameries in Detroit who report a saving of \$4,800 yearly by using *Tycos* Instruments—the Sixth Sense of Industry.

And the same manufacturer has gone a step farther in insuring the purity of his product by putting *Tycos* Temperature Regulators on his low hydro-pressure bottle washers which allows the bottles being washed, sterilized and cooled to 45° and then immediately filled without being handled. This insures putting out a product with the minimum of bacteria content.

If you are in charge of manufacturing any product that goes through heat treating processes it will pay you to investigate the possibility of saving money and insuring the uniform quality of your product by installing *Tycos* Instruments in your plant. We make 8,000 varieties of heat indicating, recording and controlling instruments. Just tell us what you make and we will send you informative literature—or our engineer will consult with you on the application of *Tycos* to your particular manufacturing process.

Taylor Instrument Companies

Main Office and Factory
ROCHESTER, N. Y. . . . U.S.A.
Canadian Plant: 5th BUILDING, TORONTO
SHORT & MASON, Ltd., Manufacturing Distributors in Great Britain

Tycos for the Home

- Tycos* Office Thermometers
An aid in promoting human efficiency.
- Tycos* Bath Thermometers
To enable you to get the most good from your bath.
- Tycos* Wall Thermometers
To help you to maintain a temperature in your house conducive to good health.
- Tycos* Storneguide
Forecasts the weather twenty-four hours ahead with dependable accuracy.
- Tycos* Hygrometer
To enable you to keep the humidity of the atmosphere in your home correct at all times.
- Tycos* Home Set
Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.
- Tycos* Fever Thermometers
A necessity in every home.
- Tycos* Quality Compasses
To show you the right way in unfamiliar country.
Your dealer will show them to you.

Tycos for the Medical Profession

- Tycos* Sphygmomanometer, Pocket and Office types.
- Tycos* Urinalysis Glasses.
- Tycos* Fever Thermometers.

Ask us, on a postal, for booklets on any of the above.

Bulletins *Tycos* on Request



Tycos Temperature Instruments

INDICATING • RECORDING • CONTROLLING



When you build a working model

FOR power to run a working model, we recommend a miniature electric motor, powered with a set of Eveready Columbia Dry Batteries. This is a combination that's light enough to make the model and its self-contained power plant fully portable. The batteries have long-lasting pep and power, and furnish current wherever they are, independent of outside wires. This is the simplest and cheapest and safest source of power for models. But be sure you get Eveready Columbias, for theirs is the stamina that puts a demonstration through to a flying finish.

NATIONAL CARBON COMPANY, INC.
New York  San Francisco

Unit of Union Carbide and Carbon Corporation

**EVEREADY
COLUMBIA
Dry Batteries**
-they last longer

6

FOR RADIO: You'll buy fewer and better dry cell "A" batteries if you insist on the Eveready Dry Cell Radio "A," No. 7111. This special cell, 1½ volts, is built by a new process and lasts unusually long in radio service.

We Made No Mistake— Neither Will You

*For seven successive radio seasons
every Bremer-Tully product has
been outstanding.*

with
Bremer-Tully

RADIO



*Time
Tried
and
Time
Proved*



B-T 7-71

The
B-T Speaker—
A Better
Reproducer—
Dynamic
or Magnetic



**Be There
with BT**

B-T 8-20



Bremer-Tully offer you:

*Quality that only
years of experience
can bring—*

*Satisfaction that
comes only from
having the best—*

Seven years of highest
quality radio manufactur-
ing experience is behind
every Bremer-Tully prod-
uct.

Every B-T product is
Quality throughout. No
single item was ever built
to sell on price—yet you
will find that Bremer-
Tully quality costs less in
the end—and brings you
much greater satisfaction
in the meantime.

There is a Quality dealer
near you who will dem-
onstrate, if you desire.

Send Coupon for details.

Are You Interested in Television?

We are at work. Send the coupon and we will advise
you as soon as there is anything definite.

*Seven models of radio receivers fill every
reasonable requirement—\$139.00 to \$739.00*

Bremer-Tully Mfg. Company
656-662 Washington Blvd.
Chicago, Ill.

C O U P O N

Send details on ☐ RADIO RECEIVERS

☐ CANTEN SPEAKERS

☐ DYNAMIC SPEAKERS

☐ DEMONSTRATION

☐ TELEVISION

Name

Street

City State